Information Resources on the Care and Use of Insects

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1968-2004

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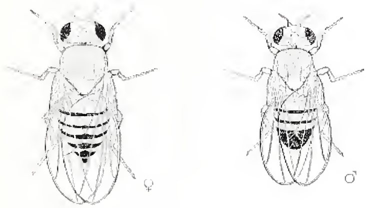
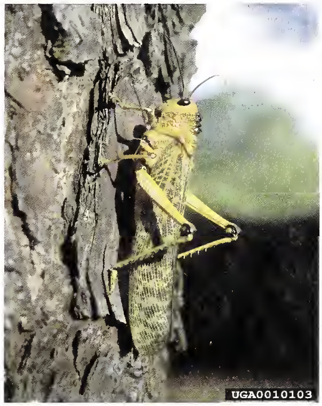


Images of male and female *Drosophila melanogaster* from THE PHYSICAL BASIS OF HEREDITY

Thomas Hunt Morgan

Philadelphia: J.B. Lippincott Company 1919

Courtesy of The Interactive Fly



Giant Brown cricket
Insecta > Orthoptera > Acrididae
Tropidacris dux (Drury)
Billings, Ronald. Texas Forest Service.
Image 0010103.
www.insectimages.org. October 22, 2002.

Six-toothed bark beetle
Insecta > Coleoptera > Scolytidae
Ips sexdentatus (Boerner)
Passoa, Steve. USDA APHIS PPQ.
Image 1669027.
www.insectimages.org. July 9, 2001.

Ants
Insecta > Hymenoptera > Formicidae
Clemson University. Image 1235140.
www.insectimages.org. August 19, 2003.

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Information Resources on the Care and Use of Insects

Contents

How to Use This Guide*

Insects offer an incredible advantage for many different fields of research. They are relatively easy to rear and maintain. Their short life spans also allow for reduced times to complete comprehensive experimental studies. The introductory chapter in this publication highlights some extraordinary biomedical applications. Since insects are so ubiquitous in modeling various complex systems such as nervous, reproduction, digestive, and respiratory, they are the obvious choice for alternative research strategies. Their opportunities lie vastly unexplored.

Insects' biological processes are temperature dependant and they have allowed us to view biochemical pathways and intermediate steps in ways that would be impossible with other warm blooded animal models. They are an economical alternative to vertebrate models and less labor intensive than more traditional laboratory animals. From a societal standpoint, invertebrates may be more acceptable for research than vertebrates. Many scientists, either by law or policy, are required to consider ways to reduce the number of animals proposed for an experiment, refine their techniques to minimize pain and distress, and replace with a non-animal model or a phylogenetically lower species. Since research has not yet shown invertebrate cognition of what would be considered pain in mammals and birds, their use is also a refinement alternative.

This guide, *Information Resources on the Care and Use of Insects*, provides a snapshot of how insects are being used in research and industry. The citations included also review how they are utilized, cultured, reared, and housed in the laboratory and elsewhere. References extracted scan the publication years 2004 to approximately 1968 and resulted from searching numerous scientific and technical databases. The call number is included for materials in the National Agricultural Library's (NAL) collection. See the document delivery information (included) for additional details.

The websites and organizations at the end of some sections are current through April 2004. They were found by running general searches on the World Wide Web. As sites can become outdated or relocated and new sites emerge, a general search on one of the commercial search engines should help locate address changes or new sites if the addresses included no longer function.

* Information included in this portion of this publication and other web-resources sections were adapted from *Information Resources for the Care and Use of Invertebrates* (published previously in AWIC by Michael D. Kreger, Ph.D.) and included with his permission.

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Chapter 5

INSECT MODELS FOR BIOMEDICAL RESEARCH

Richard G. Andre, Robert A. Wirtz, and Yesu T. Das

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"For many problems there is an animal on which it can most conveniently be studied" — the August Krogh Principle.[1]

I. INTRODUCTION

The vast numbers of species of insects and other arthropods offer tremendous possibilities for medical research. Meglitsch included the insects in his statement; "It is no accident that nearly all truly basic zoological discoveries have been based on studies of invertebrates."[2]

The major advantages of using insect models include the ease and low cost of rearing large numbers of specimens. The more commonly used laboratory insects can be reared or purchased at a fraction of the cost of mice, rats, and other laboratory animals. Reduced per diem costs and space requirements also result in significant savings. The rapid reproduction and maturation and the large number of offspring from a single male-female pairing of some species are distinct advantages over vertebrate models. The potential number of descendants from a single pair of insects, such as the housefly *Musca domestica*, is 10^{18} in a matter of months, permitting research designs using multicellular animals which usually are viewed to be restricted to single-cell organisms.[2] The flexibility afforded by use of short-lived species also can be exploited using many insect models. Experiments often can be run in months or a few years using large genetically homogeneous populations. The ability to use large numbers of test specimens can be exploited to arrive at highly significant statistical results and the detection of low-frequency occurrences. Opportunities for studies in embryology are especially promising because of the detailed knowledge of egg and larval development in some insect species. Since it is often easier to isolate physiological or pharmacological systems in insect models, these usually can be studied more simply in insects. Invertebrate tissue cultures, although initially difficult to establish, usually can be handled more easily than vertebrate systems.[3] The use of animals lower on the evolutionary scale also reduces objections by antivivisectionist and animal rights groups, a major concern of scientists today.

II. INSECTS AS A GROUP

A. MORPHOLOGY AND PHYSIOLOGY

Insects differ in their morphology and physiology from mammals in a number of ways.[4] In particular, insects possess an external exoskeleton rather than bone — the only vertebrate tissue they lack.[2] This chitinous structure provides a great deal of protection against a number of environmental stresses, such as desiccating conditions, chemicals, and pressure. Within this exoskeleton is the body cavity (hemocoel) which contains systems for digestion, circulation, respiration, excretion, innervation, and reproduction (see Figure 1). Unlike mammals, there is an open blood system with a dorsal heart and blood (hemolymph) which contains no hemoglobin. The hemolymph is responsible for a variety of transportation and immunological functions. Insect respiration is provided by a branching series of tubes called the tracheal system and by passive diffusion of oxygen to individual cells. Analogous to the vertebrate liver is a tissue known as insect fat body. This group of specialized cells is enclosed in a membranous sheath and is important in insect metabolism. Insects have a well-developed neuromuscular system. The insect organs and muscles are innervated through a series of ganglia that form a ventral nerve cord (see Figure 2). The nervous system is similar to that of mammals in having a blood-brain barrier and cholinergic synapses; however, the neuromuscular junctions are glutaminergic, unlike the vertebrate cholinergic junctions. Reproductive mechanisms in insects are quite species specific, but in general the two sexes mate via a complex chemical, visual, and tactile communication system.[4]

B. HUSBANDRY AND ECONOMICS OF REARING

The development and use of animal models for biomedical research depend upon the

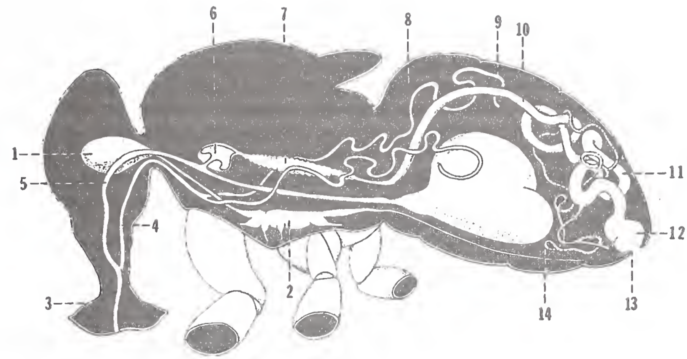

FIGURE 1. Longitudinal cross-section of an adult housefly (diagrammatic) showing gross internal organization: (1) esophageal ganglion, (2) compound thoracic ganglion, (3) pharynx, (4) salivary duct, (5) esophagus, (6) proventriculus, (7) stomach, (8) hemocoel, (9) salivary gland, (10) proximal intestine, (11) distal intestine, (12) rectum, (13) anus, and (14) Malpighian tubule. (Modified after Patton[66] and West.[67])

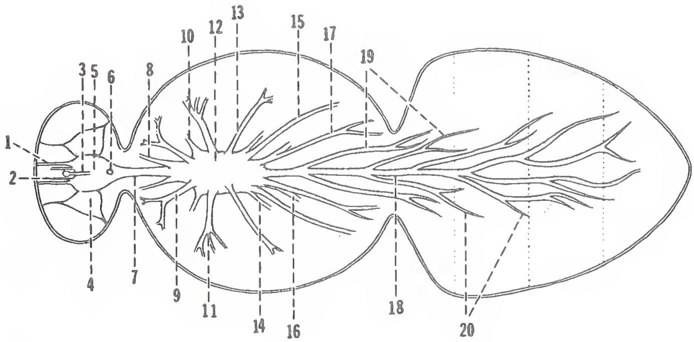

FIGURE 2. Gross nervous system of an adult housefly (diagrammatic): (1) antennary nerve, (2) pharyngeal nerve, (3) ocellar nerve, (4) optic peduncle, (5) cephalic ganglion, (6) space for esophagus, (7) cephalo-thoracic nerve cord, (8) cervical nerve, (9) prothoracic dorsal nerve, (10) prothoracic crural nerve, (11) mesothoracic dorsal nerve, (12) compound thoracic ganglion, (13) accessory mesothoracic dorsal nerve, (14) mesothoracic crural nerve, (15) metathoracic dorsal nerve, (16) metathoracic crural nerve, (17) accessory metathoracic dorsal nerve, (18) abdominal nerve cord, (19) abdominal nerves of thoracic origin, and (20) abdominal nerves of local origin. (Modified after Hewitt[68] and West.[67])

production of the needed specimens which must meet quality control requirements within specific cost restrictions. The great advantage of insects for use in biomedical studies is the ease with which these biological organisms can be reared.

Successful rearing is dependent upon a detailed knowledge of the biology, behavior, habitat, and nutritional requirements of the insect species selected. This knowledge has been expanded greatly in the past few decades, with numerous descriptions appearing in the

literature on rearing methods and diets for selected insects and other arthropods.[5] Some of the most widely used insects are often those most easily reared, such as the flies, Lepidoptera larvae, and other insects of economic importance. The housefly *M. domestica* is reared easily on CSMA (Chemical Specialties Manufacturers Association), a diet that provides year-round rearing on an efficient medium. The commercial availability of artificial and defined diets for some lepidopteran larval species significantly reduces the trouble and expense of feeding. Quality control of diet ingredients is essential to ensure proper insect nutrition at the lowest possible cost. A list of the more important references on insect diets is given by Singh.[5]

The containers and enclosures used for rearing often dictate the success of the operation. Desirable characteristics of rearing containers include economics, barrier to microbial contaminations and pathogens, allowance for gas exchange, moisture regulation, visibility and accessibility, convenience of handling and harvesting, and ease of cleaning and disinfection or disposal.[6]

The rearing procedures usually described are designed for the production of hundreds to thousands of specimens per week. Mechanized mass rearing systems also have been developed where the number of insects reared is measured in millions per week. As part of a sterile-male screwworm eradication program, approximately 500 million flies were produced per week.[7] However, production on this scale requires uniquely designed facilities to meet the needs of controlled environments, mechanized handling methods and control of pathogens, contaminants, and respiratory hazards.[8]

III. DISCOVERIES AND APPLICATIONS IN BIOMEDICAL SCIENCES

A. GENETICS

The study of genetics in multicellular organisms has progressed rapidly during the past 80 years. The fruit fly *Drosophila melanogaster* has become the best-known model for laboratory and field studies of genetics. This insect was used first as the basis for amplifying Mendelian genetics and giving it its present form. In 1910, Morgan[9] at Columbia University reported the crisscross nature of sex linkage in *Drosophila* and, more importantly, set the standards of excellence for experimental work in genetics.[10] Dobzhansky[11] was the first scientist to integrate the results of laboratory and field studies with the predictions arising from mathematical theory such as the Hardy-Weinberg law. Since Morgan's initial report in 1910,[9] it is estimated that over 25,000 articles dealing with *Drosophila* have been published and that the literature would double every 12 years.[12]

The advantages of using the fruit fly *Drosophila* as a model for the study of genetics are many.[12] The adult fly is small, readily handled, and breeds prolifically in the laboratory and in the field. Conditions for rearing the flies are simple, cheap, and readily controlled. The life cycle is short, about 9 d, and thousands can be produced in a small space. There are only four haploid chromosomes, and the polytene chromosomes of the salivary glands of larvae are gigantic and show a characteristic banding pattern. These patterns facilitate the detection of chromosomal rearrangements, the mapping of gene deficiencies, and the subsequent cytological localization of genes. Since the homologous chromosomes do not undergo crossing over in the germ cells of the male,[13] the genetic procedures employed are simplified greatly. This insect can serve as host to a variety of viruses,[14] thereby allowing the study of the genetics of host-parasite interactions. *D. melanogaster* flourishes upon many media; however, a synthetic, minimal medium has been developed upon which flies can be reared aseptically.[15] Schneider[16] has developed a medium for *in vitro* cell cultures of fly-derived cells. Massive collections of hereditary variations in flies have been developed, and stocks of many of the mutants can be obtained from various workers in the field. Finally,

an encyclopedic body of information on *Drosophila* genetic studies is readily available through indexed bibliographies, such as those by Herskowitz.[17-21] Without question, these attributes make this insect model one of the more important findings in the field of genetics, as well as in modern science.

B. MUTAGENICITY TESTING

The fruit fly *D. melanogaster* has also proved to be extremely useful in testing materials for mutagenicity, and the literature on this subject is abundant.[22] Studies of mutation induction in *Drosophila* began with Muller's experiments with X-rays in 1927.[23] In the years after World War II, the mutagenic effects of radiation were studied extensively, and Auerbach and co-workers were the first to detect chemical mutagenesis by mustard gas and formaldehyde using *Drosophila*.[23,24]

The wealth of specific test strains, special markers, inversions, and other rearrangements make it possible to test for most of the genetoxic end points relevant to human hazards using *Drosophila*. These range from recessive lethals or visible point mutations and small deletions to translocations, duplications, meiotic or mitotic recombinations, and dominant lethals or chromosome loss as an indication of open, unrepaired breaks, chromosome damage, and aneuploidy.[22,25,26] Testing for the different types of mutations often can be conducted simultaneously if desired. The life cycle of *D. melanogaster* is short enough to permit rapid analysis of many progeny but long enough to distinguish between chronic, acute, and fractionated doses.[22] Since the fruit fly is a multicellular eukaryote, it possesses a cellular and chromosomal organization more akin to mammals than the bacteria sometimes used for the initial screening of mutagens. The overlap between the mutagenic and carcinogenic potential of many classes of chemicals tends to make the distinction between the two an artificial one.[25,26]

Indirect mutagens and carcinogens require activation by the microsomal enzyme systems present in the mammalian liver. Mutagens of this kind register as negative in microbial test systems unless host-mediated assays or plating on microsomal extracts from mammalian tissues are employed. Mammalian-like detoxification pathways have been demonstrated in *Drosophila* and are capable of facilitating similar enzymic reactions to those from mammalian liver. Thus, the use of *Drosophila* is convenient for detecting indirect mutagens and short-lived metabolites. Over 50 compounds, falling into 9 different groups, that all require metabolic activation for the manifestation of their mutagenic and carcinogenic properties have been tested in *Drosophila* and yielded positive responses.[26,27]

Many of the advantages of using the fruit fly listed in the preceding section apply also to mutagenicity testing. Toxicity testing using a housefly model is described in Chapter 6.

C. PATHOGEN PRODUCTION

Many human pathogens, such as bacteria, protozoa, rickettsia, viruses, and helminths, multiply in various insects. These insect hosts may be involved in the natural transmission of certain pathogens to man. Insect-borne diseases, such as malaria, trypanosomiasis, and dengue, account for the loss of millions of people each year, particularly in tropical areas. Scientists, however, have learned to take advantage of this pathogen-insect relationship in disease diagnosis.

A unique application exploiting parasite development in insect vectors is xenodiagnosis. The causative organism of some arthropod-transmitted diseases often occurs only sparsely in human blood, making nonacute forms of the disease difficult to diagnose by recovery of the parasite. Xenodiagnosis involves the feeding of noninfected insects on the patient. After incubation and multiplication in the insect's body, the parasite, if present, may be recovered and examined. Xenodiagnosis is used most commonly in the detection of trypanosomes causing Chagas' disease (American trypanosomiasis) in the gut and feces of conenose bugs

fed 1 to 2 weeks earlier on patients.[28] More recently, phlebotomine sand flies and simuliid black flies have been used for the diagnosis of New World leishmaniasis[29] and onchocerciasis,[30] respectively.

Insects are used also in the laboratory confirmation of certain human viral illnesses, such as those caused by the dengue viruses. Dengue is one of the most important arthropod-borne viruses that occurs in man because of the high numbers of individuals infected and because it may cause mortality in children. The four viruses that cause this disease, however, are among the most difficult to detect and propagate in the laboratory. They are not very pathogenic when inoculated into the brain of a newborn mouse and may require many serial passages to produce signs of illness in mice. The application of cell culture techniques for detection led to more sensitive assays, but not all four virus types would produce consistently cytopathic effects which could be detected in the cultured cells. Upon discovery that the dengue virus grew to high titers in certain mosquitoes, workers began inoculating virus into mosquitoes to develop a more sensitive detection system.[31]

The use of mosquitoes to assay dengue viruses offers a considerable advantage in sensitivity whether the viruses are present in mosquitoes, in sera from naturally infected humans, or have been adapted to cell cultures or mice.[32] The discovery that male mosquitoes, such as *Aedes aegypti*, are as sensitive to infection as females, offers a significant advantage in safety, since males cannot transmit the infection should they escape. It was shown also that *Toxorynchites* mosquitoes, a genus that does not feed on blood and is extremely large, could be infected with the virus. This mosquito currently is the genus of choice for the laboratory confirmation of the four dengue viruses.[31]

D. NEUROENDOCRINE CONTROL MECHANISMS

Insect metamorphosis has been a fascinating phenomenon from ancient times. However, it was not until 1922 when an insight into this phenomenon was gained by Kopec.[33] He showed that a chemical factor had to be released from the brain of the gypsy moth larva, *Lymantria dispar*, to cause pupation. This was the first evidence in the animal kingdom that the nervous system was involved in the endocrine control of growth and development. We now know that the vertebrate hypothalamic-hypophyseal complex provides the same coordination of the nervous and endocrine activities as the pars intercerebralis-corpora cardiaca complex of insects. The first evidence on the mode of action of steroid hormones at cellular and molecular level came from the studies of Clever and Karlson in the 1960s on the polytene chromosomes of a fly, *Chironomus* sp.[34] The role of cyclic nucleotides in insect hormone action provides a commonality in the mode of action of insect hormones with those of mammals such as serotonin.[35] The discovery that RNA and protein syntheses were important to the action of insect hormones has yielded basic information of great significance to the mode of action of hormones in general.

E. ANTIMALARIAL DRUGS

Insects have proved very effective in the screening of potential drugs, in particular, with antimalarial compounds. Following World War II and our experience with malaria in vast numbers of military troops serving in tropical areas, malaria research centered on the development of more effective drugs. At this time, there was the need for newer testing methods to seek out compounds with antimalarial activity. The need derived from the fact that testing methods using the vertebrate hosts of avian and simian malarias, ordinarily used for preliminary evaluation of compounds for antimalarial activity, failed to show a consistent relation between the activity in animal models and that in human beings. For example, paludrine had a prophylactic effect against the avian malaria *Plasmodium gallinaceum* but not against the human malaria *P. vivax*. Consequently, preliminary evaluation of this compound required the use of experimentally infected human volunteers. Furthermore, other

compounds were not being considered because of their lack of activity against avian or simian malaria and may have been overlooked because they had not been tested against the human malarias.[36]

This need for drug-testing methods which showed drug effects in human malarias was met, in part, by studies in which various antimalarial compounds were administered to the mosquito hosts (*Anopheles quadrimaculatus, Aedes aegypti*) of *Plasmodium falciparum* and other malarias, and in which drug action was evaluated by its morphological and physiological effects on the various stages of the malaria cycle within the mosquito.[37-39] As a result of these studies, a specific relation in drug action between the mosquito and the human liver cycle of malaria was shown. Those compounds that had a prophylactic action in the mosquito, also had a prophylactic effect in the human being. As a consequence of this relation, it became possible to evaluate compounds for prophylactic activity against human malarias by using mosquitoes infected with human malarial strains as the test animal. This reduced the need for tests of drug activity in other animal models.[36]

In addition to the reduced need for animal testing, this insect model made possible a greatly expanded and accelerated malaria drug testing program at a comparatively low cost. With the discovery that drugs tested against avian malaria in the mosquito reliably predicted possible curative activity against *P. vivax*, this insect model was considered even more useful.[36] However, in the 1960s the discovery of several new nonhuman primate models led to decreased utilization of the insect model, although it was and still is a valid and much less expensive model.

F. BIOLUMINESCENCE

Insects have been used also to study the fate of various biochemical components like adenosine triphosphate during bioluminescence. Self-luminescence, not involving bacteria, occurs in insects from the orders Collembola, Homoptera, Diptera, and Coleoptera.[4] Bioluminescence has been characterized best in the common North American firefly, *Photinus pyralis*. Firefly luciferase catalyzes the adenosine triphosphate (ATP)-dependent oxidative decarboxylation of luciferin (LH_2), resulting in the production of light ($h\nu$) as shown in the reaction where P denotes the product oxyluciferin:

$$LH_2 + ATP + O_2 = P + AMP + CO_2 + h\nu$$

The reaction catalyzed by this enzyme has a quantum yield of 0.88 with respect to LH_2, making it the most efficient bioluminescent reaction known.[40] Firefly luciferase is useful in a variety of applications. Because of its specificity for ATP, firefly luciferase can be used to measure the amount of ATP present in biological samples without interference from other nucleotide triphosphates.[41] Using luciferase isolated from fireflies, in conjunction with suitably sensitive liquid scintillation counters or biometers, less than 1 fmol (10^{-15} mol) of ATP can be detected.[42] The level of endogenous ATP in a cell may be used as an index of its energy status and is therefore useful in metabolic and physiological studies. Estimates of cell numbers in microbial and tissue cultures may be obtained after determining the ATP per cell under defined conditions and measuring total ATP in a sample of culture.[43] This has served as a basis for rapidly quantitating bacteria in urine, milk, wine, and polluted waters, with sufficient sensitivity to detect the ATP contents of as few as 10 colony-forming units (CFU) per milliliter.[44] Replacing radiolabels (e.g., ^{125}I) with luciferin- or firefly luciferase-conjugated ligands in a bioluminescent immuno- or affinity-assay, can result in increased assay sensitivity, elimination of hazardous radiolabeled compounds, increased speed of the assay, and decreased cost per assay.[45] Commercially available firefly luciferase reagents for use in these assays have been evaluated by Leach and Webster.[46]

IV. AREAS OF POTENTIAL RESEARCH

A. GENERAL CONSIDERATIONS

Insects, by their enormous species diversity and antiquity, present a wide choice of biological parameters. There appears to be no common ancestry between mammals and insects. Interestingly, the basic biological functions are essentially similar in these diverse animal groups. Among the various insect species, cockroaches may be considered as relatively primitive, while bees and flies may be considered more advanced in terms of evolution. Vertebrate evolution, of course, is much more recent than that of insects; however, certain basic mechanisms are conserved throughout the animal kingdom. Therefore, the chances are high of finding a body function or a control mechanism of biomedical interest in insects. Based on the current status of our knowledge on comparative physiology, biochemistry, and molecular biology, the following areas of research appear promising for biomedical purposes.

B. SPECIFIC AREAS

1. Insectan Antibiotics

Because of their long history of survival on this planet, insects may be looked at as the founders of successful defensive mechanisms. They possess a complex, multicomponent, active defensive system that is regulated and coordinated by several distinct cell populations.[47,48] They exhibit cellular and humoral defensive mechanisms as well as the acquisition of a protected ("immune") state to bacterial infections.

The insect immunocytes (hemocytes) are efficient in eliminating bacteria, fungi, nematodes, and other foreign particles by either phagocytosis, nodule formation, or encapsulation. The recognition of foreignness is thought to be mediated by certain hemolymph proteins (agglutinins; lectins) that function as opsonins.[49] Lectins, which may play a role in the receptor-mediated endocytosis, also have been found on the cell surface of insect hemocytes.[49-52]

Insect immunocytes, namely, plasmatocytes and granulocytes, are functionally comparable to vertebrate (mammalian) B- and T-lymphocytes.[48] The plasmatocytes perform the analogous killer function and helper-cell-independent cytotoxic function of the T-lymphocytes. The plasmatocytes also perform the functions of vertebrate macrophages. The granulocytes perform the analogous functions of the B-lymphocytes as well as the suppressor functions of the T-lymphocytes. A detailed hypothesis on the evolution of these immunocytes from a primitive arthropod granulocyte was proposed recently.[48]

Insect hemolymph is rich in a polyphenoloxidase that catalyzes, among others, the oxidation of tyrosine to 3,4-dihydroxyphenylalanine. It has been proposed that the activation of this enzyme may have a role in the recognition of foreign particles.[53]

A broad spectrum of antibiotic proteins and peptides are known to be synthesized by insects in response to bacterial infections. For example, the cecropins (3.5 to 4 kDa) and attacins (20 to 23 kDa) in the hemolymph of silkworm, *Hyalophora cecropia,* are bactericidal.[54-60] The site of synthesis of these proteins or related bactericidal proteins appears to be the fat body. Insect lysozymes exhibit properties (thermostability, pH optima, and ionic strength optima) similar to those of chicken egg white lysozyme.[57,61-63]

In spite of some significant progress made in the past decade in our understanding of invertebrate immunity, our present knowledge of cellular recognition and mediation of immune response is lagging severely behind that of mammalian immunity. Future research, therefore, should concentrate on cell-surface and humoral molecules, their characterization, synthesis, regulation, and possible specificity against human pathogens and toxins. Because of the absence of mammalian-type diversification of cell functions, the insect immunocytes may provide an array of molecules for both basic and applied research in immunology. As a reward, one might be able to identify antibiotic molecules that are very different from

TABLE 1
Homologous/Analogous Aspects Between the Neuroendocrine Systems of Insects and Vertebrates[a]

Insects	Vertebrates
Neuroendocrine System	
Axoplasmic neurosecretion flow	Axoplasmic neurosecretion flow
Paired groups of neurosecretory cells in the protocerebrum	Hypothalamic neurosecretory center
Corpus cardiacum	Posterior lobe of pituitary gland
Corpus allatum	Adenohypophysis
	Anterior lobe of hypophysis
Chemistry of Neuropeptides	
Peptidergic neurosecretions; allatostatin/allatinhibin	Oxytocin, vasopressin, somatostatin
Corpus cardiacum secretions	Substance P, glucagon, insulin, secretin
Proctolin	β-Endorphin
Control of Reproductive Activity	
Synthesis of vitellogenins is extraovarial	Synthesis of vitellogenins is extraovarial
Vitellogenins synthesized in fat body	Vitellogenins synthesized in liver
Reproduction cyclic	Reproduction cyclic
Vivipary/ovovivipary	Pregnancy
Reproductive quiescence terminated by denervation of corpus allatum	Reproductive quiescence terminated by denervation of mammary gland or hypophysectomy
Egg diapause hormone secreted by subesophageal ganglion or other parts	Embryonic diapause (delayed implantation of fertilized egg) controlled by hypothalamic-adenohypophysial system

[a] Modified after Reference 65.

those of mammals and perhaps were never acquired by the mammals through the evolutionary process, either deliberately or accidentally. For example, the inability of the human immunodeficiency virus (HIV) to replicate in insect cells[64] might lead to a novel insectan molecular weapon against this deadly virus now threatening millions of people.

2. Neuroendocrine System

"The episodic events, including the molting cycle and metamorphic transformations that lead to the emergence of adult insects, are programmed with greater precision than the developmental steps leading to maturity in most vertebrates. The cyclicality in the reproductive activity of the females of certain insect species resembles that of mammals."[65] Some of the homologies and analogies are shown in Table 1. The identity and precise biological activity of many neurosecretory materials are currently under investigation in many laboratories. One can conclude at this point that the insects possess a very complex array of neurosecretions that may not be very different from those of mammals. It is hoped that future research efforts will be directed toward a clear understanding of these historical molecules and a better understanding of our own molecular systems.

V. SUMMARY

Insects as models for biomedical research offer attractive alternatives to the use of higher

animals, particularly in light of dwindling research dollars and increasing protests by animal rights groups. A major advantage of using insect models is the ease with which large numbers of specimens can be reared; reduced per diem costs and space requirements result in significant savings. The flexibility afforded by use of short-generation species also can be exploited using insect models, and experiments can be run with large genetically homogeneous populations. Although insects differ from mammals in their morphology and physiology in a number of ways, it is often easier to isolate physiological or pharmacological systems in insect models.

Scientists have taken advantage of insect models in the past and have made significant discoveries in the biomedical sciences using them. The fruit fly *Drosophila melanogaster* has become the best-known model for laboratory and field studies of genetics. An encyclopedic body of information on *Drosophila* genetic studies is readily available through indexed bibliographies, proving that this insect model is one of the more important findings in the field of genetics. The fruit fly model has been also valuable in testing materials for their mutagenic and carcinogenic properties. Scientists have learned to use insect-pathogen transmission models to screen antipathogen chemical compounds and to diagnose certain human diseases. In addition, insect models have been used to study such diverse fields as the mode of action of steroid hormones and bioluminescence. For example, the role of cyclic nucleotides in insect hormone action provides a basis for studies on the animal hormone serotonin, and determinations of total ATP using insect luciferase have facilitated the estimation of low bacterial numbers in urine, milk, wine, and water. Current emphasis on utilizing insects as models for biomedical research has been in the fields of immunology and neuroendocrinology.

ACKNOWLEDGMENT

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Laboratory Care/ Research

Drosophila

2004

Marin, M.C.; Rodriguez, J.R.; Ferrus, A. (2004) **Transcription of *Drosophila* Troponin I gene is regulated by two conserved, functionally identical, synergistic elements.** *Molecular Biology of the Cell.* 15(3): 1185-1196. ISSN: 1059-1524.
NAL Call Number: QH604.C452
Descriptors: molecular genetics, biochemistry, molecular biophysics, muscular system, Diptera, *Anopheles, Drosophila pseudoobscura,* chromosome, sarcomere, suppressor of Zeste 3 gene products, Troponin I, intron regulatory element, myocyte enhancer factor 2, upstream regulatory element, transcription initiation site, Drosophila wings-up A gene, LacZ gene, quantitative reverse transcriptase-polymerase chain reaction, genetic and laboratory techniques, transgenesis, biochemistry studies, physiology, comparative study.

Scamborova, P.; Wong, A.; Steitz, J.A. (2004) **An intronic enhancer regulates splicing of the twintron of Drosophila melanogaster prospero pre-mRNA by two different spliceosomes.** *Molecular and Cellular Biology.* 24(5): 1855-1869. ISSN: 0270-7306.
NAL Call Number: QH506.M664
Descriptors: development, molecular genetics, biochemistry and molecular biophysics, Diptera, *Drosophila melanogaster*, U12-type spliceosome, pros-L, S messenger RNA,-generation, alternative splicing, intronic enhancer, prospero twintron, systematic deletion/mutation analysis, genetic and laboratory techniques, embryogenesis, twintron splicing, comparative study, experimental morphology, physiology and pathology.

Senger, K.; Armstrong, G.W; Rowell, W.J.; Kwan, J.M.; Markstein, M.; Levine, M. (2004) **Immunity regulatory DNAs share common organizational features in *Drosophila*.** *Molecular Cell.* 13(1): 19-32. ISSN: 1097-2765.
Descriptors: immune system, chemical coordination and homeostasis, infection, molecular genetics, biochemistry and molecular biophysics, Diptera, *Drosophila,* fat body, Dif--REL-containing protein, transcription factor, Dorsal--REL-containing protein, GATA synergy, eukaryotic enhancer, consensus binding site, immunity regulatory DNA, transcription start site, SELEX assay, laboratory techniques, comparative study, experimental morphology, physiology and pathology.

Tamura, K.; Subramanian, S.; Kumar, S. (2004) **Temporal patterns of fruit fly (Drosophila) evolution revealed by mutation clocks.** *Molecular Biology and Evolution.* 21(1): 36-44. ISSN: 0737-4038.
NAL Call Number: QH506.M642
Descriptors: evolution and adaptation, molecular genetics, biochemistry and molecular biophysics, paleobiology, terrestrial ecology, Diptera, *Drosophila erecta, Drosophila melanogaster,* fruit fly, model organism, *Drosophila montium, Drosophila orena, Drosophila simulans, Drosophila takahashii, Drosophila teisseri, Drosophila yakuba,*

nuclear genome sequence, sequence comparison, genetic techniques, laboratory techniques, mathematical and computer techniques, biogeographic data, fossil records, gene sequence data, genomic mutation distances, habitat fragmentation, molecular clock, mutation clock, paleoclimate changes, speciation events, temporal evolution patterns, environmental biology.

Zhong, Y.; Wu, C.F. (2004) **Neuronal Activity and Adenylyl Cyclase in Environment-Dependent Plasticity of Axonal Outgrowth in *Drosophila*.** *Journal of Neuroscience.* 24(6): 1439-1445. ISSN: 0270-6474.
Descriptors: adenylate cyclase, cyclic AMP, phosphodiesterase, cell adhesion molecule, nerve cell plasticity, nerve fiber growth, nervous system development, *Drosophila*, environmental factor, temperature sensitivity, larva, neuromuscular synapse, potassium channel, temperature sensitive mutant, enzyme activity, protein expression, rearing, ion channel, gene, neurology, developmental biology and teratology.

2003

Houle, D.; Rowe, L. (2003) **Natural selection in a bottle.** *American Naturalist.* 161(1): 50-67. ISSN: 0003-0147.
NAL Call Number: 470 AM36
Descriptors: natural selection, laboratory evolution, constraint, life history, development time, age at maturity, norm of reaction, guppies, *Poecilia reticulate*, plant physiological traits, *Drosophila melanogaster*, body size, environment interactions, directional selection, genetic polymorphism, correlated responses, differing selection.

2002

Drier, E.A.; Tello, M.K.; Cowan, M.; Wu, P.; Blace, N.; Sacktor, T.C.; Yin, J.C. (2002) **Memory enhancement and formation by atypical PKM activity in *Drosophila melanogaster*.** *Nature Neuroscience.* 5(4): 316-324. ISSN: 1097-6256.
Descriptors: *Drosophila melanogaster*, protein kinase C, long term potentiation, *Caenorhabditis elegans*, persistent activation, consolidated memory, cell polarity, M Zeta, maintenance, bazooka, facilitation.

Florin, A.B.; Odeen, A. (2002) **Laboratory environments are not conducive for allopatric speciation.** *Journal of Evolutionary Biology.* 15(1): 10-19. ISSN: 1010-061X.
NAL Call Number: QH359 J68
Descriptors: allopatric speciation, bottlenecks, divergent selection, effective population size, meta analysis, peripatric speciation, reproductive isolation, speciation experiments, vicariance speciation, founder flush speciation, *Drosophila pseudoobscura*, reproductive isolation, genetic revolutions, evolution, selection, populations, direction.

Geiger-Thornsberry, G.L.; Mackay, T.F. (2002) **Association of single-nucleotide polymorphisms at the Delta locus with genotype by environment interaction for sensory bristle number in *Drosophila melanogaster*.** *Genetical Research.* 79(3): 211-218. ISSN: 0016-6723.
NAL Call Number: 443.8 G283
Descriptors: stabilizing selection, quantitative variation, mutations, fitness, maintenance,

populations, sensory bristles.

Matos, M.; Avelar, T.; Rose, M.R. (2002) **Variation in the rate of convergent evolution: adaptation to a laboratory environment in *Drosophila subobscura*.** *Journal of Evolutionary Biology.* 15(4): 673-682. ISSN: 1010-061X.
NAL Call Number: QH359 J68
Descriptors: ecology, evolutionary biology, genetics and heredity, adaptation, convergence, *Drosophila subobscura*, evolutionary trajectory, novel environment, life history, genetic divergence, uniform selection, stress resistance, populations, senescence, components, responses, culture.

Norry, F.M.; Loeschcke, V. (2002) **Temperature-induced shifts in associations of longevity with body size in *Drosophila melanogaster*.** *Evolution.* 56(2): 299-306. ISSN: 0014-3820.
NAL Call Number: 443.8 EV62
Descriptors: body size, cold-stress tolerance, developmental time, *Drosophila melanogaster*, longevity, trade-offs, trait associations, life-history traits, environment, interaction, natural selection, experimental populations, phenotypic plasticity, laboratory evolution, correlated responses, artificial selection, quantitative trait, male fruitflies.

Sheeba, V.; Chandrashekaran, M.K.; Joshi, A.; Sharma, V.K. (2002) **Locomotor activity rhythm in *Drosophila melanogaster* after 600 generations in an aperiodic environment.** *Naturwissenschaften.* 89(11): 512-514. ISSN: 0028-1042.
NAL Call Number: 474 N213
Descriptors: laboratory populations, persistence, senescence, evolution, *Drosophila melanogaster.*

2001

Ackermann, M.; Bijlsma, R.; James, A.C.; Partridge, L.; Zwaan, B.J.; Stearns, S.C. (2001) **Effects of assay conditions in life history experiments with *Drosophila melanogaster*.** *Journal of Evolutionary Biology.* 14(2): 199-209. ISSN: 1010-061X.
NAL Call Number: QH359 J68
Descriptors: biology, miscellaneous ecology, genetics and heredity, assay environment, *Drosophila*, genotype environment interaction, life history, selection experiments, correlated responses, artificial selection, laboratory evolution, natural selection, phenotypic plasticity, postponed senescence, genetic correlations, larval development, body weight, trade offs.

da Silva, L.B.; Valente, V.L. (2001) **Body size and mating success in *Drosophila willistoni* are uncorrelated under laboratory conditions.** *Journal of Genetics.* 80(2): 77-81. ISSN: 0022-1333.
NAL Call Number: 442.8 J823
Descriptors: behavior, genetics, morphology, Diptera, *Drosophila willistoni*, female, male, wing length analysis, F1 progeny analysis, body size analysis, copulations, environmental effects, mating activity/success analysis, cytogenetics, behavioral biology, comparative behavior, anatomy and histology, comparative and experimental

morphology, physiology and pathology.

Hoffmann, A.A.; Hallas, R.; Sinclair, C.; Partridge, L. (2001) **Rapid loss of stress resistance in *Drosophila melanogaster* under adaptation to laboratory culture.** *Evolution.* 55(2): 436-438. ISSN: 0014-3820.
NAL Call Number: 443.8 EV62
Descriptors: biology, ecology, genetics, heredity, *Drosophila melanogaster*, laboratory adaptation, stress resistance, life history, desiccation resistance, starvation resistance, selection, populations, evolution, tolerance, environments, components, longevity.

Linnen, C.; Tatar, M.; Promislow, D. (2001) **Cultural artifacts: A comparison of senescence in natural, laboratory-adapted and artificially selected lines of *Drosophila melanogaster*.** *Evolutionary Ecology Research.* 3(8): 877-888. ISSN: 1522-0613.
NAL Call Number: QH540.E96
Descriptors: *Drosophila melanogaster*, rearing techniques, laboratory culture, artificial selection, longevity selection experiments, age, senescence, effects of laboratory culture, wild vs. laboratory population comparisons, virgin males, evolutionary adaptation, laboratory environment adaptation, ageing rate, techniques, care in captivity, genetic techniques, biometrics, life cycle, development, land and freshwater zones.

Pierce, V.A.; Elghandour, R.S.; Jarrouge, E.G.; Marcin-Kiewicz, A. (2001) **Using laboratory populations of *D. melanogaster* to study adaptation of metabolic pathways.** *American Zoologist.* 41(6): 1555. ISSN: 0003-1569. Note: Annual Meeting of the Society for Integrative and Comparative Biology, Anaheim, California.
NAL Call Number: 410 AM3
Descriptors: climatology, environmental biology, evolution and adaptation, metabolism, Diptera, *Drosophila melanogaster*, fruitfly, glycolytic enzymes, phosphoglucoisomerase, phosphoglycerokinase, phosphoglyceromutase, adaptation, metabolism, temperature acclimation.

Sheeba, V.; Chandrashekaran, M.K.; Joshi, A.; Sharma, V.K. (2001) **Persistence of oviposition rhythm in individuals of *Drosophila melanogaster* reared in an aperiodic environment for several hundred generations.** *Journal of Experimental Zoology.* 290(5): 541-549. ISSN: 0022-104X.
NAL Call Number: 410 J825
Abstract: The oviposition rhythm of individual flies of *Drosophila melanogaster* from a population maintained in an aperiodic environment (with light. temperature, humidity, and other factors which could provide time cues, kept constant) for several hundred generations was assayed in constant light (LL), in light/dark (LD 12:12 hr) cycle, and in constant darkness (DD). More than 50% of the flies assayed exhibited rhythmicity in oviposition in all three light regimes. The results indicate that the phenomenon of egg laying is rhythmic in individual *D. melanogaster* females and is controlled by an endogenous time keeping mechanism. The persistence of the oviposition rhythm in a large proportion of individuals in the population after several hundred generations of rearing in a constant environment strengthens the view that possessing biological clocks may confer some intrinsic fitness advantage even to organisms living in aperiodic environments.

Descriptors: oviposition physiology, periodicity, biological clocks, *Drosophila melanogaster*, light, circadian clock, locomotor activity, light, entrainment, mechanism, timeless, zoology.

2000

Bokor, K.; Pecsenye, K. (2000) **Differences in the effect of ethanol on fertility and viability components among laboratory strains of *Drosophila melanogaster*.** *Hereditas.* 132(3): 215-227. ISSN: 0018-0661.
NAL Call Number: QH426 I13
Descriptors: alcohol dehydrogenase polymorphism, dietary ethanol, ADH locus, environmental alcohol, tolerance, temperature, metabolism; frequencies; population; selection.

De Jong, G.; Gavrilets, S. (2000) **Maintenance of genetic variation in phenotypic plasticity: the role of environmental variation.** *Genetical research.* 76(3): 295-304. ISSN: 0016-6723.
NAL Call Number: 443.8 G283
Descriptors: heredity, spatially heterogeneous environment, reaction norms, *Drosophila melanogaster*, quantitative genetics, morphological traits, polygenic variation, size characters, selection, evolution, populations.

Harshman, L.G.; Hoffmann, A.A. (2000) **Laboratory selection experiments using *Drosophila*: what do they really tell us?** *Trends in Ecology and Evolution.* 15(1): 32-36. ISSN: 0169-5347.
NAL Call Number: QH540 T74
Descriptors: long term selection, life history, postponed senescence, stress resistance, knockdown resistance, environmental stress, genetic divergence, uniform selection, replicate lines, *Drosophila melanogaster*.

Iriarte, P.F.; Hasson, E. (2000) **The role of the use of different host plants in the maintenance of the inversion polymorphism in the cactophilic *Drosophila buzzatii*.** *Evolution.* 54(4): 1295-1302. ISSN: 0014-3820.
NAL Call Number: 443.8 EV62
Descriptors: antagonistic pleiotropy, cactus hosts, *Drosophila buzzatii*, inversion polymorphism, life history traits, genotype environment interaction, evolutionary history, natural population, body size, chromosomal polymorphism, colonizing populations, quantitative genetics, heterogeneous environments, antagonistic pleiotropy, larval performance.

Matos, M.; Rose, M.R.; Pite, M.T.; Rego, C.; Avelar, T. (2000) **Adaptation to the laboratory environment in *Drosophila subobscura*.** *Journal of Evolutionary Biology.* 13(1): 9-19. ISSN: 1010-061X.
NAL Call Number: QH359 J68
Descriptors: adaptation, additive genetic correlation, additive genetic variance, *Drosophila subobscura*, novel environment, history trade off, quantitative genetics, antagonistic pleiotropy, fitness components, natural selection, *Escherichia coli*, fly,

Diptera, evolution, populations.

Nghiem, D.; Gibbs, A.G.; Rose, M.R.; Bradley, T.J. (2000) **Postponed aging and desiccation resistance in *Drosophila melanogaster*.** *Experimental Gerontology.* 35(8): 957-969. ISSN: 0531-5565.
NAL Call Number: QP86 E85
Descriptors: *Drosophila*, biomarker, stress resistance, desiccation, water loss, laboratory selection, environmental stress, respiratory pattern, cuticular lipids, senescence, responses, evolution.

Pascual, M.; Sagarra, E.; Serra, L. (2000) **Interspecific competition in the laboratory between *Drosophila subobscura* and *D. azteca*.** *American Midland Naturalist.* 144(1): 19-27. ISSN: 0003-0031.
NAL Call Number: 410 M58
Descriptors: ecology, Diptera, *Drosophila azteca*, *Drosophila subobscura*, interspecific competition, laboratory conditions, comparative and experimental morphology, physiology and pathology, environmental biology.

Prasad, N.G.; Shakarad, M.; Gohil, V.M.; Sheeba, V.; Rajamani, M.; Joshi, A. (2000) **Evolution of reduced pre-adult viability and larval growth rate in laboratory populations of *Drosophila melanogaster* selected for shorter development time.** *Genetical Research.* 76(3): 249-259. ISSN: 0016-6723.
NAL Call Number: 443.8 G283
Descriptors: genetics, heredity, dependent natural selection, *Bactrocera cucurbitae*, Diptera, life history traits, postponed senescence, artificial selection, correlated responses, mating success, body size, trade off, environment.

Teotonio, H.; Rose, M.R. (2000) **Variation in the reversibility of evolution.** *Nature.* 408(6811): 463-466. ISSN: 0028-0836.
NAL Call Number: 472 N21
Descriptors: *Drosophila melanogaster*, postponed senescence, laboratory evolution, peppered moth, history, environment, resistance, selection.

Vieira, C.; Pasyukova, E.G.; Zeng, Z.B.; Hackett, J.B.; Lyman, R.F.; Mackay, T.F. (2000) **Genotype-environment interaction for quantitative trait loci affecting life span in *Drosophila melanogaster*.** *Genetics.* 154(1): 213-227. ISSN: 0016-6731.
NAL Call Number: 442.8 G28
Descriptors: age specific patterns, bristle number, *Caenorhabditis elegans*, postponed senescence, laboratory evolution, phenotypic variation, stress resistance, genetic variance, family member, selection.

Wang, J.L. (2000) **Effects of population structures and selection strategies on the purging of inbreeding depression due to deleterious mutations.** *Genetical Research.* 76(1): 75-86. ISSN: 0016-6723.
NAL Call Number: 443.8 G283
Descriptors: *Drosophila melanogaster*, subdivided populations, artificial selection, captive populations, effective size, fitness, environment, simulation.

1999

Docquier, F.; Randsholt, N.B.; Deutsch, J.; Santamaria, P. (1999) **The 35UZ transposon of *Drosophila melanogaster* reveals differences in maintenance of transcriptional control between embryonic and larval stages.** *International Journal of Developmental Biology.* 43(3): 275-278. ISSN: 0214-6282.
Descriptors: silencing maintenance, developmental enhancers, PREs, polycomb group genes, Ubx, bithorax complex, polycomb, gene, ultrabithorax, expression, element, region, accessibility, repression, enhancers.

Frankham, R. (1999) **Resolving conceptual issues in conservation genetics: The roles of laboratory species and meta-analyses.** *Hereditas.* 130(3): 195-201. ISSN: 0018-0661.
NAL Call Number: 442.8 H42
Descriptors: environmental protection, genetics, species, natural population, experimental laboratory species, computer simulation, theory, research, wildlife, *Drosophila*, meta analysis, nonhuman, review, public health, social medical and epidemiology, clinical and experimental biochemistry.

Hoffmann, A.A.; Harshman, L.G. (1999) **Desiccation and starvation resistance in *Drosophila*: patterns of variation at the species, population and intrapopulation levels.** *Heredity.* 83(6): 637-643. ISSN: 0018-067X.
NAL Call Number: 443.8 H42
Descriptors: environmental stress, laboratory selection, life history, trade offs, opposite latitudinal clines, stress resistance, postponed senescence, physiological mechanisms, correlated responses, environmental stress, natural populations, life span, tolerance.

Orengo, D.J.; A. Prevosti (1999) **Wing-size heritability in a natural population of *Drosophila subobscura*.** *Heredity.* 82(1): 100-106. ISSN: 0018-067X.
NAL Call Number: 443.8 H42
Abstract: Heritability of wing size was determined in a natural population of *Drosophila subobscura* for two consecutive year samples. In the 1988 sample, heritability in the laboratory environment was around 15%, whereas the lower bound in nature was around 0.1%. On the other hand, in the 1989 sample, heritability in the laboratory was around 90% and in nature around 15%. Differences between the two years could be caused by the more variable climate in which the males used as fathers of the 1988 sample developed. This indicates the importance of determining the environment in which parents developed in nature before discussing the heritability values obtained.
Descriptors: *Drosophila subobscura*, wing size, length, width, heritability, populations, comparisons, laboratories, variance, environmental temperature, Spain.

Shaw, F.H.; Promislow, D.E.; Tatar, M.; Hughes, K.A.; Geyer, C.J. (1999) **Toward reconciling inferences concerning genetic variation in senescence in *Drosophila melanogaster*.** *Genetics.* 152(2): 553-566. ISSN: 0016-6731.
NAL Call Number: 442.8 G28
Descriptors: *Drosophila melanogaster*, age specific mortality, carlo maximum likelihood, life history, environment interaction, laboratory evolution, selection, variance, models, rates, components.

Shirley, M.D.; Sibly, R.M. (1999) **Genetic basis of a between-environment trade-off involving resistance to cadmium in *Drosophila melanogaster*.** *Evolution.* 53(3): 826-836. ISSN: 0014-3820.
NAL Call Number: 443.8 EV62
Descriptors: antagonistic pleiotropy, cadmium resistance, *Drosophila melanogaster*, fitness costs, life histories, metallothionein, trade-offs, metallothionein genes, life-history, terrestrial invertebrates, insecticide resistance, laboratory evolution, *Mimulus guttatus*, metal tolerance, esterase gene, heat-shock, expression.

1998

Bryant, E.H.; Meffert, L.M. (1998) **Quantitative genetic estimates of morphometric variation in wild-caught and laboratory-reared houseflies.** *Evolution.* 52(2): 626-630. ISSN: 0014-3820.
NAL Call Number: 443.8 EV62
Descriptors: heritability, maternal effects, morphometrics, environmental sex determination, *Drosophila melanogaster*, heritability, variability, populations, traits, differentiation, bottleneck, characters, selection.

Chippindale, A.K.; Gibbs, A.G.; Sheik, M.; Yee, K.J.; Djawdan, M.; Bradley, T.J.; Rose, M.R. (1998) **Resource acquisition and the evolution of stress resistance in *Drosophila Melanogaster*.** *Evolution.* 52(5): 1342-1352. ISSN: 0014-3820.
NAL Call Number: 443.8 EV62
Descriptors: developmental time, *Drosophila melanogaster*, growth rate, life-history evolution, physiology, starvation, stress resistance, trade-offs, desiccation resistance, postponed senescence, correlated responses, trade-off, starvation resistance, environmental stress, laboratory evolution, selection, tolerance, longevity.

Clark, A.G.; C.D. Fucito (1998) **Stress tolerance and metabolic response to stress in *Drosophila melanogaster*.** *Heredity.* 81(5): 514-527. ISSN: 0018-067X.
NAL Call Number: 443.8 H42
Abstract: A potentially important physiological response to stress may be alteration in the gross regulation of energy metabolism. Different genotypes may respond differently to environmental stress, and the variation in these norms of reaction may be of key importance to the maintenance of genetic variation in metabolic traits. In the study reported here, a set of genetically defined lines of *Drosophila melanogaster* were exposed to four stresses (acetic acid, ethanol, starvation and thermal stress) in order to assess the magnitude of environmental effects and genotype x environment interactions. In addition to scoring metabolic traits, distributions of survival times under each stress were also quantified. Although both metabolic traits and survival times exhibited strong differences among genotypes, the correlations between enzyme traits and survival were generally weak. Many of the genetic correlations exhibit significant heterogeneity across environments. The results suggest that transient environmental stress may play an important role in the evolution of this highly intercorrelated set of metabolic traits.
Descriptors: *Drosophila melanogaster*, stressors, acetic acid, ethanol, heat stress, starvation, line differences, tolerance, genotype environment interaction, metabolism, genotypes, genetic correlation, survival, enzyme activity, epistasis.

Fry, J.D.; S.V. Nuzhdin; E.G. Pasyukova; T.F. Mackay (1998) **QTL mapping of genotype-environment interaction for fitness in *Drosophila melanogaster*.** *Genetical Research.* 71(2): 133-141. ISSN: 0016-6723.

NAL Call Number: 443.8 G283

Abstract: A fundamental assumption of models for the maintenance of genetic variation by environmental heterogeneity is that selection favours alternative alleles in different environments. It is not clear, however, whether such antagonistic pleiotropy is common. We mapped quantitative trait loci (QTLs) causing variation for reproductive performance in each of three environmental treatments among a set of 98 recombinant inbred (RI) lines derived from a cross between two *D. melanogaster* laboratory strains. The three treatments were standard medium at 25 degrees C, ethanol-supplemented medium at 25 degrees C, and standard medium at 18 degrees C. The RI lines showed highly significant genotype-environment interaction for the fitness measure. Of six QTLs with significant effects on fitness in at least one of the environments, five had significantly different effects at the different temperatures. In each case, the QTL by temperature interaction arose because the QTL had stronger effects at one temperature than at the other. No evidence for QTLs with opposite fitness effects in different environments was found. These results, together with those of recent studies of crop plants, suggest that antagonistic pleiotropy is a relatively uncommon form of genotype-environment interaction for fitness, but additional studies of natural populations are needed to confirm this conclusion.

Descriptors: *Drosophila melanogaster*, inbred lines, genotype environment interaction, quantitative traits, loci, genetic mapping, genetic variation, pleiotropy, reproductive performance, ethanol, temperature, environmental factors.

Gause, M.; Hovhannisyan, H.; Kan, T.; Kuhfittig, S.; Mogila, V.; Georgiev, P. (1998) **Hobo-induced rearrangements in the yellow locus influence the insulation effect of the gypsy su(Hw)-binding region in *Drosophila melanogaster*.** *Genetics.* 149(3): 1393-1405. ISSN: 0016-6731.

NAL Call Number: 442.8 G28

Abstract: The su(Hw) protein is responsible for the insulation mediated by the su(Hw)-binding region present in the gypsy retrotransposon. In the y2 mutant, su(Hw) protein partially inhibits yellow transcription by repressing the function of transcriptional enhancers located distally from the yellow promoter with respect to gypsy. y2 mutation derivatives have been induced by the insertion of two Hobo copies on the both sides of gypsy: into the yellow intron and into the 5' regulatory region upstream of the wing and body enhancers. The Hobo elements have the same structure and orientation, opposite to the direction of yellow transcription. In the sequence context, where two copies of Hobo are separated by the su(Hw)-binding region, Hobo-dependent rearrangements are frequently associated with duplications of the region between the Hobo elements. Duplication of the su(Hw)-binding region strongly inhibits the insulation of the yellow promoter separated from the body and wing enhancers by gypsy. These results provide a better insight into mechanisms by which the su(Hw)-binding region affects the enhancer function.

Descriptors: *Drosophila melanogaster*, hairy wing protein, enhancer promoter, interactions, zinc finger protein, gypsy retrotransposon, regulatory elements, hybrid dysgenesis, induced mutations, cut locus, gene, suppressor, DNA binding proteins,

metabolism, gene rearrangement, genes insect, nuclear proteins, repressor proteins, retroelements, transposase, binding sites, chromosome mapping, crosses, genetic enhancer elements, gene library, phenotype, restriction mapping.

Imasheva, A.G.; V. Loeschcke; L.A. Zhivotovsky; O.E. Lazebny. (1998) **Stress temperature and quantitative variation in *Drosophila melanogaster*.** *Heredity.* 81(3): 246-253. ISSN: 0018-067X.
NAL Call Number: 443.8 H42
Abstract: Using an isofemale line analysis, we analysed the consequences of extreme rearing temperatures for genetic variation in quantitative characters in *Drosophila melanogaster*. Three types of characters were used: life history (viability and developmental time), body size (thorax length and wing length) and meristic (number of sternopleural chaetae and number of arista branches). Phenotypic variation significantly increased under stress conditions in all morphological characters studied; for viability, it increased at the low stress temperature. Genetic variation, measured by the coefficient of intraclass correlation, was generally higher at both low and high stress temperatures for thorax length and sternopleural chaeta number. For wing length and viability, genetic variation was higher at the low extreme temperature. No consistent trend was found for genetic variation in arista branch number and developmental time. Our results agree with the hypothesis that genetic variation is increased in stressful environments. A possible mechanism underlying this phenomenon is briefly discussed.
Descriptors: *Drosophila melanogaster*, air temperature, environmental temperature, genetic variation, phenotypic variation, quantitative traits, viability, biological development, time, thorax, wings, length, body parts, genotype environment interaction.

Kraft, R.; Levine, R.B.; Restifo, L.L. (1998) **The steroid hormone 50-hydroxyecdysone enhances neurite growth of *Drosophila* mushroom body neurons isolated during metamorphosis.** *Journal of Neuroscience.* 18(21): 8886-8899. ISSN: 0270-6474.
Descriptors: central nervous system, serotonin containing neurons, dendritic spine density, programmed cell death, moth *Manduca sexta*, hippocampal neurons, horseradish peroxidase, identified motoneurons, insect metamorphosis, dissociated neurons, *Drosophila* neurons.

Liimatainen, J.O.; Hoikkala, A. (1998) **Interactions of the males and females of three sympatric *Drosophila virilis*-group species, *D. montana*, *D. littoralis*, and *D. lummei*, (Diptera: Drosophilidae) in intra- and interspecific courtships in the wild and in the laboratory.** *Journal of Insect Behavior.* 11(3): 399-417. ISSN: 0892-7553.
URL: http://www.wkap.nl/journalhome.htm/0892-7553
NAL Call Number: QL496.J68
Descriptors: *Drosophila* courtship behavior, interspecies interaction, species differences, species recognition, insect environments, intraspecific vs. interspecific courtships interactions and species recognition in lab vs wild environment, *D. montana* vs *D. littoralis* vs *D. lummei*, social and instinctive behavior.

Mackay, T.F.; Lyman, R.F. (1998) **Polygenic mutation in *Drosophila melanogaster*: genotype x environment interaction for spontaneous mutations affecting bristle number.** *Genetica.* 103(SI): 199-215. ISSN: 0016-6707.

NAL Call Number: 442.8 G282
Descriptors: *Drosophila melanogaster*, bristle number, genotype environment, interaction, mutation selection balance, polygenic mutation, quantitative trait loci, P-element, insertions, stabilizing selection, genetic interactions, abdominal bristle, inbred strains, fitness, maintenance, divergence.

Mercer, J.D. (1998) **Behavioral measures of heat and lead stress in laboratory-reared *Drosophila melanogaster*.** *Dissertation Abstracts International: Section B: The Sciences and Engineering.* 58 (7-B): 3431. ISSN: 0419-4217. Note: Univ Microfilms International.
NAL Call Number: Z5055 U49D53
Descriptors: breeding, courtship behavior, environmental stress, heat effects, lead (metal), heat and lead stress, courtship success and fecundity, laboratory-reared male and female *Drosophila melanogaster*, general psychology.

Wayne, M.L.; Mackay, T.F. (1998) **Quantitative genetics of ovariole number in *Drosophila melanogaster*. II. Mutational variation and genotype-environment interaction.** *Genetics.* 148(1): 201-210. ISSN: 0016-6731.
NAL Call Number: 442.8 G28
Descriptors: P-element insertions, polygenic mutation, mating success, selection balance, bristle number, reaction norms, male, size, traits, maintenance, viability.

1997

Djawdan, M.; Rose, M.R.; Bradley, T.J. (1997) **Does selection for stress resistance lower metabolic rate?** *Ecology.* 78(3): 828-837. ISSN: 0012-9658.
NAL Call Number: 410 EC7
Descriptors: *Drosophila melanogaster*, metabolic rate, physiological response, stress resistance, postponed senescence, environmental stress, laboratory evolution, energy metabolism, desiccation, temperature, population, energetics.

Fernandez, J.; Lopez-Fanjul, C. (1997) **Spontaneous mutational genotype-environment interaction for fitness-related traits in *Drosophila melanogaster*.** *Evolution.* 51(3): 856-864. ISSN: 0014-3820.
NAL Call Number: 443.8 EV62
Descriptors: *Drosophila melanogaster*, life history traits, quantitative traits, natural populations, artificial selection, genetic variability, viability, maintenance, evolution.

Gibbs, A.G.; Chippindale, A.K.; Rose, M.R. (1997) **Physiological mechanisms of evolved desiccation resistance in *Drosophila melanogaster*.** *Journal of Experimental Biology.* 200(12): 1821-1832. ISSN: 0022-0949.
NAL Call Number: 442.8 B77
Descriptors: desiccation, fruit fly, *Drosophila melanogaster*, water balance, evolution, cuticular lipid, laboratory selection, postponed senescence, environmental stress, selection, spectroscopy, permeability, temperature, adaptation, tolerance, history.

Gilchrist, G.W.; Huey, R.B.; Partridge, L. (1997) **Thermal sensitivity of *Drosophila***

melanogaster: **Evolutionary responses of adults and eggs to laboratory natural selection at different temperatures.** *Physiological Zoology.* 70(4): 403-414. ISSN: 0031-935X.
NAL Call Number: 410 P56
Descriptors: heat shock proteins, life history traits, experimental populations, *Escherichia coli*, artificial selection, postponed senescence, environmental stress, shape variation, adaptation, resistance, *Drosophila melanogaster*.

Hoikkala, A.; Isoherranen, E. (1997) **Variation and repeatability of courtship song characters among wild-caught and laboratory-reared *Drosophila montana* and *D. littoralis* males (Diptera: Drosophilidae).** *Journal of Insect Behavior.* 10(2): 193-202. ISSN: 0892-7553.
URL: http://www.wkap.nl/journalhome.htm/0892-7553
NAL Call Number: QL496.J68
Descriptors: courtship behavior, mate selection, strain differences, vocalizations, environments, variations and repeatability of different song characters, strains of wild caught vs lab reared *Drosophila montana* and *D. littoralis*, male flies, social and instinctive behavior.

Joshi, A. (1997) **Laboratory studies of density-dependent selection: Adaptations to crowding in *Drosophila melanogaster*.** *Current Science.* 72(8): 555-562. ISSN: 0011-3891.
NAL Call Number: 475 Sci23
Descriptors: ecology, nutrition, physiology, Diptera, *Drosophila melanogaster*, crowding, density-dependent selection, food acquisition, life history, population studies, environmental biology, nutritional status and methods, comparative and experimental morphology, physiology and pathology.

Min, K.T.; S. Benzer (1997) ***Wolbachia*, normally a symbiont of *Drosophila*, can be virulent, causing degeneration and early death.** *Proceedings of the National Academy of Sciences of the United States of America.* 94(20): 10792-10796. ISSN: 0027-8424.
NAL Call Number: 500 N21P
Abstract: *Wolbachia*, a maternally transmitted microorganism of the Rickettsial family, is known to cause cytoplasmic incompatibility, parthenogenesis, or feminization in various insect species. The bacterium-host relationship is usually symbiotic: incompatibility between infected males and uninfected females can enhance reproductive isolation and evolution, whereas the other mechanisms enhance progeny production. We have discovered a variant *Wolbachia* carried by *Drosophila melanogaster* in which this cozy relationship is abrogated. Although quiescent during the fly's development, it begins massive proliferation in the adult, causing widespread degeneration of tissues, including brain, retina, and muscle, culminating in early death. Tetracycline treatment of carrier flies eliminates both the bacteria and the degeneration, restoring normal life-span. The 16s rDNA sequence is over 98% identical to *Wolbachia* known from other insects. Examination of laboratory strains of *D. melanogaster* commonly used in genetic experiments reveals that a large proportion actually carry *Wolbachia* in a nonvirulent form, which might affect their longevity and behavior.
Descriptors: *Drosophila melanogaster*, *Wolbachia rickettsia*, symbionts, strains,

virulence, lifespan, degeneration, pathogenesis, cytopathogenicity, ribosomal DNA, nucleotide sequences.

Pirrotta, V. (1997) **Chromatin-silencing mechanisms in *Drosophila* maintain patterns of gene expression.** *Trends in Genetics.* 13(8): 314-318. ISSN: 0168-9525.
NAL Call Number: QH426.T74
Descriptors: polycomb group genes, binding sites, UBX gene, regulatory sequences, bithorax complex, protein, trithorax, enhancer, domains.

Santos, M.; Borash, D.J.; Joshi, A.; Bounlutay, N.; Mueller, L.D. (1997) **Density-dependent natural selection in *Drosophila*: Evolution of growth rate and body size.** *Evolution.* 51(2): 420-432. ISSN: 0014-3820.
NAL Call Number: 443.8 EV62
Descriptors: body size, critical size, density dependent selection, development time, *Drosophila melanogaster*, efficiency, feeding rate, growth rate, trade offs, gene-environment interaction, life history traits, correlated responses, k-selection, overcrowded cultures, postponed senescence, artificial selection, competitive ability, larval competition, thorax length.

1996

Arking, R.; Force, A.G.; Dudas, S.P.; Buck, S.; Baker, G.T. (1996) **Factors contributing to the plasticity of the extended longevity phenotypes of *Drosophila*.** *Experimental Gerontology.* 31(6): 623-643. ISSN: 0531-5565.
NAL Call Number: QP86 E85
Descriptors: longevity, life span, *Drosophila*, genetic control of aging, genetic plasticity, phenotypic plasticity, environment effects, long-lived strain, elongation factor ef-1-alpha, ZN superoxide dismutase, postponed senescence, oxidative stress, environment interaction, quantitative genetics, correlated responses, laboratory evolution, evolution of phenotypic life-history, trade-offs, senescence, size at maturity, age-specific, mortality, long term cost.

Fry, J.D.; Heinsohn, S.L.; Mackay, T.F. (1996) **The contribution of new mutations to genotype-environment interaction for fitness in *Drosophila melanogaster*.** *Evolution.* 50(6): 2316-2327. ISSN: 0014-3820.
NAL Call Number: 443.8 EV62
Descriptors: antagonistic pleiotropy, environmental heterogeneity, mutation selection balance, phenotypic plasticity, quantitative genetics, larval performance, by environment, natural populations, polygenic mutation, insect herbivore, host plants, strains, maintenance, *Drosophila* gene, tissue-specific expression, P-element mutations affecting embryonic peripheral nervous-system development.

Hughes, K.; Sokolowski, M.B. (1996) **Natural selection in the laboratory for a change in resistance by *Drosophila melanogaster* to the parasitoid wasp *Asobara tabida*.** *Journal of Insect Behavior.* 9(3): 477-491. ISSN: 0892-7553.
NAL Call Number: QL496.J68
Descriptors: behavior, ecology, parasitology, pathology, physiology, Diptera,

Hymenoptera, *Asobara tabida*, *Drosophila melanogaster*, host defense, polymorphism, behavioral biology, environmental biology, comparative and experimental morphology, physiology and pathology.

Jenkinson, L.S.; Davies, A.J.; Wood, S.; Shorrocks, B.; Lawton, J.H. (1996) **Not that simple: global warming and predictions of insect ranges and abundances - results from a model insect assemblage in replicated laboratory ecosystems.** *Aspects of Applied Biology.* 45: 343-348. ISSN: 0265-1491.
NAL Call Number: QH301 A76
Descriptors: global warming, temperature, insect pests, dispersal, geographical distribution, population dynamics, greenhouse effect, climatic change, ecology, environmental factors, biology, agricultural entomology, *Drosophila melanogaster*, *Drosophila simulans*, *Drosophila pseudoobscura*, Diptera, pathogens and biogenic diseases of plants, meteorology and climate, behavior.

Marco, R.; A. Benguria; J. Sanchez; E. de Juan (1996) **Effects of the space environment on *Drosophila melanogaster* development. Implications of the IML-2 experiment.** *Journal of biotechnology.* 47(2/3): 179-189. ISSN: 0168-1656.
NAL Call Number: QH442.J69
Descriptors: *Drosophila melanogaster*, embryonic development, oogenesis, space flight, weightlessness, laboratories, biological development, centrifuges.

Weigensberg, I.; Roff, D.A. (1996) **Natural heritabilities - Can they be reliably estimated in the laboratory?** *Evolution.* 50(6): 2149-2157. ISSN: 0014-3820.
NAL Call Number: 443.8 EV62
Descriptors: additive genetic variance, narrow sense heritability, natural heritability, quantitative genetics, environmental sex determination, flycatcher *Ficedula hypoleuca*, cross fostered broods, tit *Parus major*, body size, egg size, external morphology, *Drosophila buzzatii*, tarsus length.

1995

Blows, M.W.; M.B. Sokolowski (1995) **The expression of additive and nonadditive genetic variation under stress.** *Genetics.* 140(3): 1149-1159. ISSN: 0016-6731.
NAL Call Number: 442.8 G28
Abstract: Experimental lines of *Drosophila melanogaster* derived from a natural population, which had been isolated in the laboratory for approximately 70 generations, were crossed to determine if the expression of additive, dominance and epistatic genetic variation in development time and viability was associated with the environment. No association was found between the level of additive genetic effects and environmental value for either trait, but nonadditive genetic effects increased at both extremes of the environmental range for development time. The expression of high levels of dominance and epistatic genetic variation at environmental extremes may be a general expectation for some traits. The disruption of the epistatic gene complexes in the parental lines resulted in hybrid breakdown toward faster development and there was some indication of hybrid breakdown toward higher viability. A combination of genetic drift and natural selection had therefore resulted in different epistatic gene complexes being selected after

approximately 70 generations from a common genetic base. After crossing, the hybrid populations were observed for 10 generations. Epistasis contributed on average 12 hr in development time. Fluctuating asymmetry in sternopleural bristle number also evolved in the hybrid populations, decreasing by >18% in the first seven generations after hybridization.
Descriptors: *Drosophila melanogaster*, genetic variation, dominance, epistasis, genetic effects, genetic drift, natural selection, stress, nutrient availability, lines, propionic acid, genotype environment interaction, hybrids.

Campbell, R.B.; D.R. Sinclair; M. Couling; H.W. Brock (1995) **Genetic interactions and dosage effects of Polycomb group genes of *Drosophila*.** *Molecular and general genetics.* 246(3): 291-300. ISSN: 0026-8925.
NAL Call Number: 442.8-Z34
Abstract: The Polycomb (Pc) group of genes are required for maintenance of cell determination in *Drosophila melanogaster*. At least 11 Pc group genes have been described and there may be up to 40: all are required for normal regulation of homeotic genes, but as a group, their phenotypes are rather diverse. It has been suggested that the products of Pc group genes might be members of a heteromeric complex that acts to regulate the chromatin structure of target loci. We examined the phenotypes of adult flies heterozygous for every pairwise combination of Pc group genes in an attempt to subdivide the Pc group functionally. The results support the idea that Additional sex combs (Asx), Pc, Polycomblike (Pcl), Posterior sex combs (Psc), Sex combs on midleg (Scm), and Sex combs extra (Sce) have similar functions in some imaginal tissues. We show genetic interactions among extra sex combs (esc) and Asx, Enhancer of Pc, Pcl, Enhancer of zeste E(z), and super sex combs and reassess the idea that most Pc group genes function independently of esc. Most duplications of Pc group genes neither exhibit anterior transformations nor suppress the extra sex comb phenotype of Pc group mutations, suggesting that not all Pc group genes behave as predicted by the mass-action model. Surprisingly, duplications of E(z) enhance homeotic phenotypes of esc mutants. Flies with increasing doses of esc+ exhibit anterior transformations, but these are not enhanced by mutations in trithorax group genes. The results are discussed with respect to current models of Pc group function.
Descriptors: *Drosophila melanogaster*, structural genes, DNA binding proteins, gene interaction, gene dosage, gene expression, genetic regulation, mutations, Polycomb group genes.

Cavicchi, S.; Guerra, D.; Latorre, V.; Huey, R.B. (1995) **Chromosomal analysis of heat-shock tolerance in *Drosophila melanogaster* evolving at different temperatures in the laboratory.** *Evolution.* 49(4): 676-684. ISSN: 0014-3820.
NAL Call Number: 443.8 EV62
Descriptors: acclimation, climate warming, *Drosophila melanogaster*, *D. subobscura*, heat hardening, heat tolerance, genetic analysis, induced thermotolerance, temperature, experimental populations, evolutionary adaptation, environmental factors, thermal environment, subobscura adults, *Escherichia coli*, shape variation, resistance, selection, divergence.

Draye, X.; Lints, F.A. (1995) **Geographic variations of life history strategies in *Drosophila***

melanogaster. **II. Analysis of laboratory-adapted populations.** *Experimental Gerontology.* 30(5): 517-32. ISSN: 0531-5565.
NAL Call Number: QP86 E85
ABSTRACT: Life history traits--hatchability, longevity, and egg production--of five wild-caught populations of *Drosophila melanogaster* were measured after these populations had been reared in constant laboratory conditions during a 4-year period. The results were analyzed together with those that had been obtained with the same populations just after capture. They are probably the first convincing results that reveal the existence of genetic variability for some life history traits measured in the laboratory. Besides, no significant phenotypic correlations, either positive or negative, between early and late components of fitness were found. Finally, the five populations showed different patterns of genetic correlation between early and late fitness traits. One of the populations showed a negative correlation, another showed a positive correlation, while the remaining three populations showed no correlation at all. This was equally observed at the within- and between-population levels. That result suggests that both the antagonistic pleiotropy hypothesis proposed by Williams and the concordant pleiotropy hypothesis suggested by Lints are not of general validity.
Descriptors: *Drosophila melanogaster*, genetics, fertility, longevity, variation, adaptation biological, analysis of variance, physiology, environment controlled, evolution, ovum, phenotype.

Ebbert, M.A. (1995) **Variable effects of crowding on *Drosophila* hosts of male-lethal and non-male-lethal spiroplasmas in laboratory populations.** *Heredity.* 74(3): 227-240. ISSN: 0018-067X.
NAL Call Number: 443.8 H42
Descriptors: ecology, genetics, physiology, population genetics, population studies, Diptera, *Drosophila pseudoobscura*, *Drosophila willistoni*, host fitness, maternal inheritance, dynamics, transmission rate, cytogenetics, environmental biology, comparative and experimental morphology, physiology and pathology, spiroplasmas.

James, A.C.; Partridge, L. (1995) **Thermal evolution of rate of larval development in *Drosophila melanogaster* in laboratory and field populations.** *Journal of Evolutionary Biology.* 8(3): 315-330. ISSN: 1010-061X.
NAL Call Number: QH359 J68
Descriptors: development, ecology, evolution and adaptation, genetics, morphology, physiology, Diptera, *Drosophila melanogaster*, adult body size, genetic correlation, latitudinal variation, temperature, cytogenetics, environmental biology, anatomy and histology, developmental biology, embryology, morphogenesis, comparative and experimental morphology, physiology and pathology.

Latter, B.D.; J.C. Mulley (1995) **Genetic adaptation to captivity and inbreeding depression in small laboratory populations of *Drosophila melanogaster*.** *Genetics.* 139(1): 255-266. ISSN: 0016-6731.
NAL Call Number: 442.8 G28
Abstract: The rate of adaptation to a competitive laboratory environment and the associated inbreeding depression in measures of reproductive fimess have been observed in populations of *Drosophila melanogaster* with mean effective breeding size of the order

of 50 individuals. Two large wild-derived populations and a long-established laboratory cage population were used as base stocks, from which subpopulations were extracted and slowly inbred under crowded conditions over a period of 210 generations. Comparisons have been made of the competitive ability and reproductive fitness of these subpopulations, the panmictic populations produced from them by hybridization and random mating and the wild- or cage-base populations from which they were derived. After an average of approximately 180 generations in the laboratory, the wild-derived populations exceeded the resampled natural populations by 75% in fitness under competitive conditions. The cage-derived panmictic population, after a total of 17 years in the laboratory, showed a 90% superiority in competitive ability over the corresponding wild population. In the inbred lines derived from the wild-base stocks, the average rate of adaptation was estimated to be 0.33 + 0.06% per generation. However, the gain in competitive ability was more than offset by inbreeding depression at an initial rate of approximately 2% per generation. The effects of both adaptation and inbreeding on reproductive ability in a noncompetitive environment were found to be minor by comparison. The maintenance of captive populations under noncompetitive conditions can therefore be expected to minimize adaptive changes due to natural selection in the changed environment.
Descriptors: *Drosophila melanogaster*, inbreeding depression, laboratory populations, competitive ability, cages, competition, inbred lines, adaptation, fecundity, reproductive performance, body weight, biological development, genetic distance, heterozygosity , alloenzymes, genetic variation, enzyme polymorphism, intraspecific competition, crowding, New South Wales, Australian capital territory.

Latter, B.D.; J.C. Mulley; D. Reid; L. Pascoe (1995) **Reduced genetic load revealed by slow inbreeding in *Drosophila melanogaster*.** *Genetics.* 139(1): 287-297. ISSN: 0016-6731. NAL Call Number: 442.8 G28
Abstract: The rate of decline in reproductive fitness in populations of *Drosophila melanogaster* inbred at an initial rate of appoximately 1% per generation has been investigated under both competitive and noncompetitive conditions. Breeding population size was variable in the inbred lines with an estimated harmonic mean of 66.7 +/- 2.2. Of the 60 lines maintained without reserves, 75% survived a period of 210 generations of slow inbreeding and were then rapidly inbred by full-sib mating to near-homozygosity. The initial rate of inbreeding was estimated to be 0.96 +/- 0.16% per generation, corresponding to an effective population size of approximately 50. However, the rate of inbreeding declined significantly with time to average only 0.52 +/- 0.08% per generation over the 210 generation period, most likely due to associative overdominance built up by genetic sampling and selection in the small populations. The total inbreeding depression in fitness was estimated to be 87 +/- 3% for competitive ability and 27 +/- 5% for fitness under uncrowded conditions, corresponding to rates of decline of 2.0 +/- 0.3 and 0.32 +/- 0.07%, respectively, per 1% increase in the inbreeding coefficient. The frequency of lethal second chromosomes in the resultant near-homozygous lines was of the order of 5%, lethal free second chromosomes showed a mean viability under both crowded and uncrowded conditions of approximately 95%, and their population cage fitness was 60% that of Cy/+ heterozygotes. It can be concluded that homozygous genotypes from which deleterious genes of major effect have been eliminated during slow inbreeding may show far less depression in reproductive fitness than suggested by earlier studies of wild

chromosome homozygotes. The loss in fitness due to homozygosity throughout the entire genome may be as little as 85-90% under competitive conditions, and 25-30% in an optimal environment.
Descriptors: *Drosophila melanogaster*, inbreeding depression, genetic load, lethals, competition, competitive ability, crowding, inversion, segregation, wild strains, laboratory strains, cages, fecundity, reproductive performance, body weight, biomass, inbred lines, homozygosity, intraspecific competition, New South Wales, Australian capital territory.

Partridge, L.; Barrie, B.; Barton, N.H.; Fowler, K.; French, V. (1995) **Rapid laboratory evolution of adult life-history traits in *Drosophila melanogaster* in response to temperature.** *Evolution.* 49(3): 538-544. ISSN: 0014-3820.
NAL Call Number: 443.8 EV62
Descriptors: body size, *Drosophila melanogaster*, fecundity, fertility, fitness, intrinsic rate of increase, life-span, temperature, thermal sensitivity, male fruitflies, span, environment, adaptation, mutation.

Wright, N.J.; Zhong, Y. (1995) **Characterization of K+ currents and the cAMP-dependent modulation in cultured *Drosophila* mushroom body neurons identified by LacZ expression.** *Journal of Neuroscience.* 15(2): 1025-1034. ISSN: 0270-6474.
Descriptors: K+ current, mushroom body, *Drosophila*, CAMP, modulation, LACZ, mediated enhancer detection, central nervous system, potassium channels, ion channels, sodium channels, single channel, shaker, mutants, locus, gene.

1994

Hodgetts, R.B.; M.S. Patel; J. Piorecky; A.D. Swan; C. Spencer (1994) **Identification of a sequence motif upstream of the *Drosophila* Dopa decarboxylase gene that enhances heterologous gene expression.** *Genome.* 37(4): 526-534. ISSN: 0831-2796.
NAL Call Number: QH431.G452
Abstract: In this paper we have examined the role that element S, a DNA sequence motif found approximately 215 bp upstream of the Dopa decarboxylase (Ddc) gene, might play in regulating Ddc expression. Nearly identical versions of the element are present upstream of four other *Drosophila* genes. For two of these, the element appears to be an important component of the upstream regulatory region, since mutations in it reduce expression of the downstream gene. Because an element S polymorphism differentiates the Ddc+ allele of an inbred laboratory strain from the Ddc+4 allele present in a strain isolated from the wild, we decided to test the activity of both forms. Oligonucleotides containing Ddc+ or Ddc+4 versions of element S were synthesized and their ability to drive the expression of an heterologous (Adh) reporter gene at the second molt was examined. Transgenic larvae carrying the element S-Adh fusion constructs consistently exhibited Adh levels that were elevated 1.5-fold above those seen in control organisms. We have also determined the effects of element S in white prepupae and once again, ADH expression levels were significantly above controls in both groups of transformants carrying the element S construct. The results point to a functional role for element S. Since reporter gene expression in third instar larvae was restricted to tissues where ADH is normally found, we conclude that element S is not involved in directing the tissue

specificity of Ddc expression. However, its ability to enhance heterologous gene expression suggests that it may be the fifth in the set of cis-acting sequences in the complex regulatory domain known to specify epidermal Ddc expression during development.
Descriptors: *Drosophila melanogaster*, DNA, nucleotide sequences, element S, structural genes, carboxylyases, genetic regulation, gene expression, reporter genes, alcohol dehydrogenase, recombinant DNA, gene splicing, transgenic strains.

Krstevska, B.; Hoffmann, A.A. (1994) **The effects of acclimation and rearing conditions on the response of tropical and temperate populations of *Drosophila melanogaster* and *D. simulans* to a temperature gradient (Diptera: Drosophilidae).** *Journal of Insect Behavior.* 7(3): 279-288. Notes: 17 ref.
NAL Call Number: QL496.J68
Descriptors: temperature, pest insects, behavior, *Drosophila melanogaster*, *Drosophila simulans*, biology, environmental factors, Diptera, Drosophilidae, noxious species.

Leroi, A.M.; W.R. Chen; M.R. Rose (1994) **Long-term laboratory evolution of a genetic life-history trade-off in *Drosophila melanogaster*. 2. Stability of genetic correlations.** *Evolution.* 48(4): 1258-1268. ISSN: 0014-3820.
NAL Call Number: 443.8 Ev62
Descriptors: *Drosophila melanogaster*, genetic correlation, genotype environment interaction, life history, fecundity, starvation, longevity, artificial selection.

Leroi, A.M.; A.K. Chippindale; M.R. Rose (1994) **Long-term laboratory evolution of a genetic life-history trade-off in *Drosophila melanogaster*. 1. The role of genotype-by-environment interaction.** *Evolution.* 48(4): 1244-1257. ISSN: 0014-3820.
NAL Call Number: 443.8 Ev62
Descriptors: *Drosophila melanogaster*, pleiotropy, genotype environment interaction, life history, fecundity, ovaries, weight, longevity, population density, evolution, nutrient availability, starvation, artificial selection.

Miller, P.S. (1994) **Is inbreeding depression more severe in a stressful environment?** *Zoo Biology.* 13(3): 195-208. ISSN: 0733-3188.
NAL Call Number: QL77.5.Z6
Descriptors: captive breeding, competition, *Drosophila*, genetic variation, reintroduction.

Santos, M.; K. Fowler; L. Partridge (1994) **Gene-environment interaction for body size and larval density in *Drosophila melanogaster*: an investigation of effects on development time, thorax length and adult sex ratio.** *Heredity.* 72(5): 515-521. ISSN: 0018-067X.
NAL Call Number: 443.8 H42
Abstract: We measured the effect of larval density on thorax length, development time, sex ratio and a measure of total fitness, using strains of *Drosophila melanogaster* artificially selected for increased thorax length, control lines otherwise cultured in an identical way, and the base stock from which the lines had been derived. We used the addition experimental design (Mather and Caligari, 1981). No genotype-environment interaction was observed when comparing the reduction in thorax length of 'large' and 'control' lines with increasing larval density for any culture series, i.e. rank ordering of

genotypes and additive genetic variances remained the same in all the environments tested. In contrast, the reduction in thorax length for the base stock as density increased was proportionally smaller than that of the 'large' and 'control' lines. Development time increased more rapidly with larval density in the 'large' lines than in the 'controls' or base stock. Sex ratio was unaffected by larval density but thorax length and the development time of females were more affected than those of males by increasing larval density. The estimate of total fitness showed clear evidence of gene-environment interaction for the effect of body size on fitness, with genetically large individuals at an increasing disadvantage with increasing larval density.
Descriptors: *Drosophila melanogaster*, genotype environment interaction, population density, larvae, sex ratio, thorax, length, biological development, time, genetic variance, body length.

1993

Aspi, J.; A. Hoikkala (1993) **Laboratory and natural heritabilities of male courtship song characters in *Drosophilia montana* and *D. littoralis*.** *Heredity.* 70(4): 400-406. ISSN: 0018-067X.
NAL Call Number: 443.8 H42
Abstract: We estimated heritabilities for several male courtship song characters in two *Drosophila* species using father-son regression under conditions where both fathers and sons had been raised in the laboratory. In *D. montana* the heritabilities of song characters were rather high (-0.23 to 0.80) and in most cases significant. In *D. littoralis* the heritabilities of song characters were generally lower (-0.33 to 0.18), and none of them was significantly larger than zero. We also estimated heritabilities regressing characters of wild-caught fathers with those of their laboratory reared sons, and used the method employed by Riska et al. to estimate the lower bound of heritabilities in nature. In *D. montana* most and in *D. littoralis* all of the across-environment heritabilities were non-significant (-0.15 to 0.43 and -0.04 to 0.15, respectively), and in some cases the across-environment heritabilities were significantly lower than the heritabilities measured under laboratory conditions. The low across-environment heritabilities appeared to be due to larger phenotypic variability of song characters in the field and in some cases also due to genotype-environment interactions.
Descriptors: *Drosophila montana*, *D. littoralis*, heritability, mating behavior, sound production, genotype environment interaction, sexual selection, male courtship songs.

Good, D.S. (1993) **Evolution of behaviors in *Drosophila melanogaster* in high-temperatures-genetic and environmental-effects.** *Journal of Insect Physiology.* 39(7): 537-544. ISSN: 0022-1910.
NAL Call Number: 421 J825
Descriptors: searching behavior, temperature preference, laboratory natural selection, genetics, Diptera, *Drosophila melanogaster*, differentiation, consequences, orientation, populations, selection, duration.

Kohler, R.E. (1993) ***Drosophila*: A life in the laboratory.** *Journal of the History of Biology.* 26(2): 281-310. ISSN: 0022-5010.
NAL Call Number: QH305 J6

Descriptors: ecology, education, evolution and adaptation, history, physiology, Diptera, *Drosophila*, evolution, genetics, teaching tool, textbooks, education, audio-visual aids, general biology-history and archaeology, environmental biology, comparative and experimental morphology, pathology.

Service, P.M. (1993) **Laboratory evolution of longevity and reproductive fitness components in male fruit flies: mating ability.** *Evolution.* 47(2): 387-399. ISSN: 0014-3820.
NAL Call Number: 443.8 Ev62
Descriptors: cell biology, development, ecology, evolution and adaptation, genetics, physiology, reproductive system, Diptera, *Drosophila melanogaster*, development, fertility, inbreeding, longevity, mutation accumulation, thorax length, cytology and cytochemistry, genetics and cytogenetics, environmental biology, physiology and biochemistry, developmental biology, embryology, morphogenesis, comparative and experimental morphology, pathology.

Thomas, R.H.; J. S. Barker (1993) **Quantitative genetic analysis of the body size and shape of *Drosophila buzzatii*.** *Theoretical and applied genetics.* 85(5): 598-608. ISSN: 0040-5752.
NAL Call Number: 442.8 Z8
Abstract: Body size in *Drosophila* is known to be closely related to a number of traits with important life history consequences, such as fecundity, dispersal ability and mating success. We examine the quantitative genetic basis of body size in three populations of the cactophilic species *Drosophila buzzatii*, which inhabit climatically different areas of Australia. Flies were reared individually to eliminate any common environmental component in a full-sib design with families split between two temperatures (18 degrees and 25 degrees C). The means of several size measures differ significantly among populations while the genetic correlations among these traits generally do not differ, either among populations from different natural environments or between the different laboratory temperatures. This stability of correlation structure is necessary if laboratory estimates of genetic correlations are to have any connection with the expression of genetic variation in the field. The amount of variance due to genotype-by-environment interactions (family X temperature of development) varied among populations, apparently in parallel with the magnitudes of seasonal and diurnal variation in temperature experienced by the different populations. A coastal population, inhabiting a relatively thermally benign environment, showed no interaction, while two inland populations, inhabiting thermally more extreme areas, showed interaction. This interaction term is a measure of the amount of genetic variation in the degree of phenotypic plasticity of body size in response to temperature of development. Thus the inland flies vary in their ability to attain a given body size at a particular temperature while the coastal flies do not. This phenotypic plasticity is shown to be due primarily to differences among genotypes in the amount of response to the change in temperature. A possible selective basis for the maintenance of genetic variation for the levels of phenotypic plasticity is proposed.
Descriptors: *Drosophila buzzatii*, genotype environment interaction, life history, anatomy, size, environmental temperature, seasonal variation, temporal variation, quantitative genetics, genetic correlation, geographical distribution, environmental factors, races, genetic variation, phenotypes, genotypes, thorax, wings, length, Australian

populations.

1992

Ahmed, A.A. (1992) *Genetical studies on natural and laboratory population of Drosophila melanogaster: Environmental effects on multiple mating.* Alexandria Univ. (Egypt). Faculty of Agriculture, Thesis Degree: Thesis (M.Sc. in Genetics) 111 p. Notes: 11 ill. 13 tables; Bibliography: p. 98-108.
Descriptors: *Drosophila melanogaster*, mating systems, laboratory population, environmental factors, animal husbandry, methods, Diptera.

Falb, D.; Fischer, J.; Maniatis, T. (1992) **Rearrangement of upstream regulatory elements leads to ectopic expression of the *Drosophila mulleri* Adh-2 gene.** *Genetics.* 132(4): 1071-9. ISSN: 0016-6731.
NAL Call Number: 442.8 G28
Abstract: The Adh-2 gene of *Drosophila mulleri* is expressed in the larval fat body and the adult fat body and hindgut, and a 1500-bp element located 2-3 kb upstream of the Adh-2 promoter is necessary for maximal levels of transcription. Previous work demonstrated that deletion of sequences between this upstream element and the Adh-2 promoter results in Adh-2 gene expression in a novel larval tissue, the middle midgut. In this study we show that the upstream element possesses all of the characteristics of a transcriptional enhancer: its activity is independent of orientation, it acts on a heterologous promoter, and it functions at various positions both 5' and 3' to the Adh-2 gene. Full enhancer function can be localized to a 750-bp element, although other regions possess some redundant activity. The ectopic expression pattern is dependent on the proximity of at least two sequence elements. Thus, tissue-specific transcription can involve complex proximity-dependent interactions among combinations of regulatory elements.
Descriptors: *Drosophila*, genetics, enhancer elements, gene expression regulation, regulatory sequences, nucleic acid, gene deletion, gene rearrangement, genes structural, intestines, enzymology, pseudogenes, RNA messenger, restriction mapping, transcription.

Gebhardt, M.D.; S.C. Stearns (1992) **Phenotypic plasticity for life-history traits in *Drosophila melanogaster*. III. Effect of the environment on genetic parameters.** *Genetical research.* 60(2): 87-101. ISSN: 0016-6723.
NAL Call Number: 443.8 G283
Abstract: We estimated genetic and environmental variance components for developmental time and dry weight at eclosion in *Drosophila melanogaster* raised in ten different environments (all combinations of 22, 25 and 28 degrees C and 0.5, 1 and 4% yeast concentration, and 0.25% yeast at 25 degrees C). We used six homozygous lines derived from a natural population for complete diallel crosses in each environment. Additive genetic variances were consistently low for both traits (h2 around 10%). The additive genetic variance of developmental time was larger at lower yeast concentrations, but the heritability did not increase because other components were also larger. The additive genetic effects of the six parental lines changed ranks across environments, suggesting a mechanism for the maintenance of genetic variation in heterogenous

environments. The variance due to non-directional dominance was small in most environments. However, there was directional dominance in the form of inbreeding depression for both traits. It was pronounced at high yeast levels and temperatures but disappeared when yeast or temperature were decreased. This meant that the heterozygous flies were more sensitive to environmental differences than homozygous flies. Because dominance effects are not heritable, this suggests that the evolution of plasticity can be constrained when dominance effects are important as a mechanism for plasticity.
Descriptors: *Drosophila melanogaster*, genetic variance, phenotypes, life history, genotype environment interaction, heritability, biological development, body weight, line differences, temperature, nutrient availability, inbreeding depression.

Graves, J.L.; Toolson, E.C.; Jeong, C.; Vu, L.N.; Rose, M.R. (1992) **Desiccation, flight, glycogen, and postponed senescence in *Drosophila melanogaster*.** *Physiological Zoology.* 65(2): 268-286.
NAL Call Number: 410 P56
Descriptors: *Drosophila melanogaster*, epicuticular hydrocarbon composition, life history, environmental stress, laboratory evolution, resistance, selection, *Pseudoobscura*, permeability, mechanisms, tolerance.

1991

Garcia-Dorado, A.; P. Martin; N. Garcia (1991) **Soft selection and quantitative genetic variation: a laboratory experiment.** *Heredity.* 66(3): 313-323. ISSN: 0018-067X.
NAL Call Number: 443.8 H42
Abstract: The effect of environmental heterogeneity on the genetic variation of different quantitative characters was studied in two laboratory and two recently captured populations of *Drosophila melanogaster*. Two different culture media (habitats R and G) were used. Coarse-grained heterogeneity with independent density control in each habitat (R + G), and fine-grained (R/G) heterogeneity were simulated in population cages. Control populations in both R and G habitats were also maintained. Genetic differences for oviposition-site preference, larval preference and/or within-habitat viability were found between subpopulations sampled from different media. This happened in all four populations maintained on R + G, two populations maintained on R/G, and one control population. Thus, environmental heterogeneity seems to protect genetic variability responsible for between-habitat genetic differentiation, particularly when such heterogeneity corresponds to the 'soft selection' model (R + G). However, for the quasi-neutral trait sternopleural bristle number, no genetic between-habitat differentiation, nor increased heritability were observed in populations maintained under any kind of environmental heterogeneity. Hence, although soft selection seems to be a real force in determining adaptation to heterogeneous environments, the genetic variability maintained may be small in relation to the whole genome.
Descriptors: *Drosophila melanogaster*, genetic variation, soft selection, genotype environment interaction, environmental factors, habitat selection, larvae, heritability, bristles, phenotypes, oviposition, culture media, types.

Oudman, L.; Vandelden, W.; Kamping, A.; Bijlsma, R. (1991) **Polymorphism at the Adh and Alpha-GPDH loci in *Drosophila melanogaster*- effects of rearing temperature on**

developmental rate, body-weight, and some biochemical parameters. *Heredity.* 67: 103-115.
NAL Call Number: 443.8 H42
Descriptors: ADH, alpha-GPDH, developmental time, *Drosophila melanogaster*, temperature, weight, alcohol-dehydrogenase locus, sn-glycerol-3-phosphate dehydrogenase, enzyme polymorphisms, natural selection, dietary ethanol, fitness, allozymes, larvae, environment, adaptation.

1990

Craig, C.L. (1990) **Effects of background pattern on insect perception of webs spun by orb-weaving spiders.** *Animal behavior.* 39(1): 135-144. ISSN: 0003-3472.
NAL Call Number: 410 B77
Abstract: Recent studies show that many insects are able to see spider webs and avoid them. The orb-spinning spiders and their close relatives are an abundant and diverse group of predators that make use of a variety of habitats and light environments. A combination of field and laboratory approaches was used to explore the effects of light environment, silk reflectance and background pattern on insect perception of spider webs. Field experiments showed that in dim visual habitats, background patterns have no significant effect on insect perception of webs but in bright visual habitats, patterns behind webs decreased the ability of insects to see and avoid them. In the laboratory *Drosophila melanogaster meigen* have more difficulty seeing brightly lit webs when they are suspended close to backgrounds of high spatial frequencies than when webs are suspended in front of distant backgrounds or of low spatial frequencies. When *Drosophila* are confronted with webs characterized by low reflectivity, however, they are unable to see and avoid them, regardless of light level or background spatial pattern. Web visibility results from a series of complex interactions among the reflectance properties of silks, web architecture, background pattern, ambient light level and the peculiar visual physiology of the approaching insect.
Descriptors: *Drosophila melanogaster*, perception, Araneae, spider webs, light, silk reflectance, background patterns.

Weber, K.E. (1990) **Selection on wing allometry in *Drosophila melanogaster*.** *Genetics.* 126 (4): 975-989. ISSN: 0016-6731.
NAL Call Number: 442.8 G28
Abstract: Five bivariate distributions of wing dimensions of *Drosophila melanogaster* were measured, in flies 1) subjected to four defined environmental regimes duringdevelopment, 2) taken directly from nature in seven U.S. states, 3) selected in ten populations forchange in wing form, and 4) sampled from 21 long inbred wild-type lines. Environmental stresses during development altered both wing size and the ratios of wing dimensions, but regardless of treatmentall wing dimensions fell near a common allometric baseline in each bivariate distribution. Thewings of wild-caught flies from seven widely separated localities, and of their laboratory-rearedoffspring, also fell along the same baselines. However, when flies were selected divergently for lateral offsetfrom these developmental baselines, response to selection was rapid in every case. The mean divergencein offset between oppositely selected lines was 14.68 SD of the base population offset, afteronly 15 generations of selection at 20%. Measurements of 21

isofemale lines, founded from wild-caughtflies and maintained in small populations for at least 22 years, showed large reductions inphenotypic variance of offsets within lines, but a large increase in the variance among lines. Thevariance of means of isofemale lines within collection localities was ten times the variance of means amonglocalities of newly established wild lines. These observations show that much additive genetic varianceexists for individual dimensions within the wing, such that bivariate developmental patterns can bechanged in any direction by selection or by drift. The relative invariance of the allometricbaselines of wing morphology in nature is most easily explained as the result of continuous naturalselection around a local optimum of functional design.
Descriptors: *Drosophila melanogaster*, lines, artificial selection, selection responses, wing size, allometry, genetic variation, genotype environment interaction, heritability, environmental factors, stress, phenotypes, variation, geographical distribution, Arizona, Connecticut, Massachusetts, Minnesota, Oregon, Pennsylvania, Vermont.

1989

Barnes, P.T.; B. Holland; V. Courreges (1989) **Genotype-by-environment and epistatic interactions in *Drosophila melanogaster*: the effects of Gpdh allozymes, genetic background and rearing temperature on larval developmental time and viability.** *Genetics.* 122(4): 859-868. ISSN: 0016-6731.
NAL Call Number: 442.8 G28
Abstract: The possible role of temperature as a component of natural selection generating the latitudinal clines in Gpdh allele frequencies in natural populations of *Drosophila melanogaster* was examined. Effects of rearing temperature (16 degrees, 22 degrees, and 29 degrees) and of Gpdh allozymes (S and F) on larval developmental time and viability were measured. Eight genetic backgrounds from each of three populations (continents) were used to assess the generality of any effects. Analyses of variance indicated significant temperature effects and allozyme-by-genetic background interaction effects for both characters. Viability showed significant genetic background effects, as well as significant temperature-by-allozyme and temperature-by-allozyme-by-population interactions. In general, the S/S genotype was significantly lower in viability than the F/F and F/S genotypes at extreme temperatures (16 degrees and 29 degrees), with no significant differences at 22 degrees. However, each population had a slightly different pattern of viability associated with temperature, and only the Australian population showed a pattern that could contribute to the observed cline formation. Although the same two interactions were not significant for developmental time, examination of the means showed that the S/S genotype had a slightly faster rate of development at 16 degrees than the F/F genotype in all populations (by an average of 0.25 day or 1.1%). The low temperature effect on developmental time is consistent with the clines observed in nature, with the S allele increasing in frequency with higher latitudes. The results for both viability and developmental time are consistent with the interpretation of Gpdh as a minor polygene affecting physiological phenotypes, as indicated by previous work with adult flight metabolism. Finally, it is proposed that the temperature-dependent antagonistic effects of the allozymes on viability vs. developmental time and flight metabolism may be the underlying force giving rise to the worldwide polymorphism.
Descriptors: *Drosophila melanogaster*, larvae, genotypes, glycerolphosphate dehydrogenase, genetic analysis, genotype environment interaction, epistasis,

temperature, viability, natural selection, genetic polymorphism, analysis of variance, crosses, enzymology, growth and development, isoenzymes, larva growth and development, North America, temperature, time factors, Europe, Australia.

Prout, T.; J.S. Barker (1989) **Ecological aspects of the heritability of body size in *Drosophila buzzatii*.** *Genetics.* 123(4): 803-813. ISSN: 0016-6731.
NAL Call Number: 442.8 G28
Abstract: The heritability of thorax length in the cactophilic *Drosophila buzzatii* was determined for flies from each of 10 rotting cactus cladodes. For each rot, emerging flies were used as parents of progeny reared in the laboratory. The methods used were full sib analysis with the parents mated assortatively and also offspring-parent regression. From this, heritabilities were measured for the laboratory environment and for the natural environment of the rotting cladode. For the laboratory environment, h2 =0.3770 +/- 0.0203 and for the natural environment h2 = 0.0936 +/- 0.0087 within rots and h2 = 0.0595 +/- 0.0123 for a population drawn randomly from different rots. Because of the possibility of genotype-environment interaction between the laboratory and rot environments, the methods of B. Riska, T. Prout and M. Turelli were used to show it is possible that there is no such interaction, but if there is, the above natural heritabilities are approximate lower bounds. These results are related to the general problem of determining heritabilities in nature where it is impractical to measure both parents and progeny in nature. Determining heritability not only in nature but in relation to subdivision into ephemeral patches (cladodes in this case) has an important bearing on natural selection response and to general theories of stabilizing selection proposed to explain the existence of genetic variation. Attempts were made to detect selection by using the size of emerging adults as an indicator of various levels of larval stress. No selection was detected, but the power to do so was very weak. Differences between progeny means from different rots indicated some genetic differences between rots which can be adequately explained by small numbers of founders. This suggests a random fine scale subdivision amounting to Fst = 0.1483 +/- 0.0462.
Descriptors: *Drosophila buzzatii*, body measurements, ecology, heritability, progeny, mathematical methods.

Riska, B.; T. Prout; M. Turelli (1989) **Laboratory estimates of heritabilities and genetic correlations in nature.** *Genetics.* 123(4): 865-871. ISSN: 0016-6731.
NAL Call Number: 442.8 G28
Abstract: A lower bound on heritability in a natural environment can be determined from the regression of offspring raised in the laboratory on parents raised in nature. An estimate of additive genetic variance in the laboratory is also required. The estimated lower bounds on heritabilities can sometimes be used to demonstrate a significant genetic correlation between two traits in nature, if their genetic and phenotypic correlations in nature have the same sign, and if sample sizes are large, and heritabilities and phenotypic and genetic correlations are high.
Descriptors: plants, *Drosophila*, heritability, genetic variation, genetic correlation.

1988

Kohane, M.J.; P.A. Parsons (1988) **Domestication: evolutionary change under stress.**

Evolutionary biology. 23: 31-48. ISSN: 0071-3260.
NAL Call Number: QH308.E8
Descriptors: domestication, evolution, adaptation, *Drosophila*, foxes, genotype environment interaction, laboratory rearing, stress factors.

Markow, T.A. (1988) **Reproductive behavior of *Drosophila melanogaster* and *D. nigrospiracula* in the field and in the laboratory.** *Journal of comparative psychology.* 102(2): 169-73. ISSN: 0735-7036.
Abstract: The reproductive behaviors of two species of fruit fly, *Drosophila melanogaster* and *D. nigrospiracula*, were compared in field and laboratory populations. A number of differences were observed in the behavior of the two species in their natural habitats. *D. melanogaster*, which was observed on citrus, mates at its feeding site, whereas *D. nigrospiracula*, which is cactiphilic, mates on a non-resource-based male territory adjacent to its feeding site. In both species large male size is important for reproductive success. However, in *D. melanogaster* smaller males tended to be excluded from the breeding site and were therefore not among the pool of potential mates to which females were exposed. Sex ratios were biased toward females in both species, but the high frequency of female remating in *D. nigrospiracula* may have provided more mating opportunities for the males of this species. Field observations differed from laboratory observations, and I discuss the importance of these differences for understanding the evolution of *Drosophila* mating systems.
NAL Call Number: BF671.J6
Descriptors: *Drosophila melanogaster*, *D. nigrospiracula*, sex behavior, social environment, species specificity, social dominance, evolution of mating systems.

Mukai, T. (1988) *Genotype-environment interaction in relation to the maintenance of genetic variability in populations of Drosophila melanogaster.* Proceedings of the Second International Conference on Quantitative Genetics / edited by B.S. Weir ... [et al.]. Sunderland, Mass.: Sinauer Associates, p. 21-31. ISBN: 0878939016.
NAL Call Number: QH452.7.I58 1987
Descriptors: *Drosophila melanogaster*, genetic variation, genotype environment interaction, selection, inbreeding depression.

1987

Kohane, M.J.; Parsons, P.A. (1987) **Mating ability in laboratory-adapted and field-derived *Drosophila melanogaster*: the stress of domestication.** *Behavior Genetics.* 17(6): 541-58. ISSN: 0001-8244.
NAL Call Number: QH301.B45
Descriptors: *Drosophila melanogaster*, genetics, sex behavior, physiology, stress genetics, environment, selection genetics, temperature.

1986

Millar, C.D.; Lambert, D.M. (1986) **Laboratory-induced changes in the mate recognition system of *Drosophila pseudoobscura*.** *Behavior Genetics.* 16(2): 285-294. ISSN: 0001-

8244.
URL: http://www.wkap.nl/journalhome.htm/0001-8244
NAL Call Number: QH301.B45
Descriptors: environments, mating behavior, strain differences, species recognition, *Drosophila*, geography, geographic strain differences, mate recognition system, *Drosophila pseudoobscura* of long term laboratory stock vs new population, genetics, social and instinctive behavior.

1985

Nigro, L.; Costa, R.; Jayakar, S.D.; Zonta, L. (1985) **Est-6 in *Drosophila melanogaster*: effects of genetic composition temperature and oviposition period on fitness in laboratory populations polymorphic for rare alleles.** *Heredity.* 55(1): 83-91. ISSN: 0018-067X.
NAL Call Number: 443.8 H42
Descriptors: Diptera, *Drosophila melanogaster*, polymorphism, rare allele, esterase, fitness, genotype environment interaction, gene interaction, egg laying, enzyme.

1983

Haley, C.S.; Birley, A.J. (1983) **The genetical response to natural selection by varied environments. II. Observations on replicate populations in spatially varied laboratory environments.** *Heredity.* 51(3): 581-606. ISSN: 0018-067X.
NAL Call Number: 443.8 H42
Abstract: From each of two populations of *Drosophila melanogaster*, collected two months previously, from Chateau Tahbilk, S. Australia and Groningen, The Netherlands, duplicate populations were initiated in each of four environments which differed in their degree of environmental heterogeneity. Differing combinations of three food media based on oatmeal/treacle, potato or fig were used to simulate levels of environmental heterogeneity within the populations. The polymorphic loci, Adh, Est-6, G-6pdh, alpha-Gpdh, Pgm, Lap-D and Aph in both the Chateau Tahbilk and Groningen derived populations and 6Pgdh, which was only polymorphic in the populations which came from Chateau Tahbilk, were monitored in the experiment. The populations maintained a size of about 2500 adults and were sampled after 16 and 32 generations. Large changes of phenotype frequency were shown by all loci. Despite a frequent divergence of phenotype frequencies between duplicate cages, systematic effects of occasion and environment were present and allele frequencies at many loci were shown to be changing at a faster rate than could be due to random genetic drift. Genetic heterozygosity differed between environments but was not positively correlated with degree of environmental heterogeneity.
Descriptors: *Drosophila melanogaster* genetics, environment, selection genetics, Australia, electrophoresis, starch gel, genetics, population, Netherlands, phenotype.

1981

Barker, J.S.; G.J. Parker; G.L. Toll; P.R. Widders (1981) **Attraction of *Drosophila buzzatii* and *Drosophila aldrichi* to species of yeasts isolated from their natural environment. I.**

Laboratory experiments. *Australian journal of biological sciences.* 34(5/6): 593-612. ISSN: 0004-9417.
NAL Call Number: 442.8 AU72
Descriptors: *Drosophila buzzatii*, *Drosophila aldrichi*, yeasts, laboratory studies, attraction, ecology, environmental biology.

1980

Markow, T.A. (1980) **Rare male advantages among *Drosophila* of the same laboratory strain.** *Behavior genetics.* 10(6): 553-6. ISSN: 0001-8244.
NAL Call Number: QH301.B45
Descriptors: *Drosophila melanogaster*, sex behavior, male flies, laboratory strain, environment.

1979

Skrzipek, K.H.; Kroener, B.; Hager, H. (1979) **Inter-male aggression in *Drosophila melanogaster* - a laboratory study.** *Zeitschrift fuer Tierpsychologie.* 49(1): 87-103. ISSN: 0044-3573. Note: In German.
NAL Call Number: 410 Z35
Descriptors: aggressive behavior, environments, male flies, laboratory setting, defensive behavior, *Drosophila melanogaster*, social and instinctive behavior.

1978

Alahiotis, S. (1978) **Rate of hybridization between *Drosophila melanogaster* and *Drosophila simulans* in greek natural populations and in laboratory.** *Biologia Gallo-Hellen.* 7(1-2): 219-222.
Descriptors: Diptera, *Drosophila melanogaster*, *Drosophila simulans*, laboratory study, environmental factor, population genetics, hybridization, natural population.

Ashburner, M.; Thompson, J.N. Jr. (1978) *The Laboratory Culture of Drosophila. The Genetics and Biology of Drosophila.* Volume 2a. Academic Press. London: i-xi, 1-604, Ii-Iliv, Chapter pagination: 109. Book chapter.
Descriptors: *Drosophila*, rearing techniques, diet, culture media, parthenogenesis, incidence, life cycle, laboratory optimal conditions, developmental stages, environmental influences, parasites, diseases, in culture, humidity, temperature, survival through range, techniques, care in captivity, nutrition, reproduction, abiotic factors, physical factors.

Wallace, B. (1978) **Population size, environment, and the maintenance of laboratory cultures of *Drosophila melanogaster* (Includes genetic aspects).** *Acta biologica Iugoslavica. Serija F. Genetika.* 10(1): 9-16. ISSN: 0534-0012. Note: In English, Publisher: Yugoslav Union of Biological Sciences.
NAL Call Number: QH431.G44
Descriptors: *Drosophila melanogaster*, laboratory culture, maintenance, population size,

environment, genetics.

1976

Langley, C.H.; Ito, K. (1976) **Spontaneous mutability in *Drosophila melanogaster*, in natural and laboratory environments.** *Mutation Research.* 36(3): 385-6. ISSN: 0027-5107.
NAL Call Number: QH431.M8
Descriptors: *Drosophila melanogaster*, gene frequency, mutation, lethal, genes, recessive genes, linkage genetics, sex chromosomes.

1972

Anderson, W.W.; T. Dobzhansky; O. Pavlovsky (1972) **A natural population of *Drosophila* transferred to a laboratory environment.** *Heredity.* 28(1): 101-107. Ref.
NAL Call Number: 443.8 H42
Descriptors: laboratory population, chromosome aberrations, *Drosophila*, genetics population, adaptation biological, alleles, chromosomes, environment, evolution, gene frequency, hybridization, genetic, karyotyping, polymorphism genetics, selection genetics, statistics.

Hay, D.A. (1972) **Genetical and maternal determinants of the activity and preening behavior of *Drosophila melanogaster* reared in different environments.** *Heredity.* 28(3): 311-36. ISSN: 0018-067X.
NAL Call Number: 443.8 H42
Descriptors: *Drosophila melanogaster*, environment, models biological, analysis of variance, behavior, crosses, genotype, mortality, sex factors.

1971

Hosgood, S.M.; Parsons, P.A. (1971) **Genetic heterogeneity among the founders of laboratory populations of *Drosophila*. IV. Scutellar chaetae in different environments.** *Genetica.* 42(1): 42-52. ISSN: 0016-6707.
NAL Call Number: 442.8 G282
Descriptors: environment, genetics population, variation genetics, analysis of variance, *Drosophila melanogaster*, phenotype, temperature effects.

Other Diptera

2004

Banziger, H.; Pape, T. (2004) **Flowers, faeces and cadavers: Natural feeding and laying habits of flesh flies in Thailand (Diptera: Sarcophagidae, Sarcophaga spp.).** *Journal of Natural History.* 38(13): 1677-1694. ISSN: 0022-2933.
NAL Call Number: QH7.J6
Descriptors: behavior, biogeography, population studies, systematics and taxonomy,

terrestrial ecology, Diptera, *Sarcophaga africa, Sarcophaga albiceps,* adult, larva, *Sarcophaga annandalei, Sarcophaga dux, Sarcophaga hui, Sarcophaga konakovi, Sarcophaga krathonmai, Sarcophaga misera, Sarcophaga nathani, Sarcophaga ruficornis, Sarcophaga urceola, Sarcophaga walayari,* flesh fly, amphibiodotic, coprobiodotic, necrobiodotic, digestive system, baiting, breeding strategies, cadavers, carrion, feeding behavior, larviposition habits, laying habits, myiasis, rearing biology, comparative study, environmental biology.

Maor, M.; Kamensky, B.; Shloush, S.; Yuval, B. (2004) **Effects of post-teneral diet on foraging success of sterile male Mediterranean fruit flies.** *Entomologia Experimentalis Et Applicata.* 110(3): 225-230. ISSN: 0013-8703.
NAL Call Number: 421 En895
Descriptors: *Ceratitis capitata,* sterile insect technique, nutritional ecology, Diptera, Tephritidae, mating success, male-only releases, reproductive success, sexual compatibility, reared males, competitiveness.

Syed, Z.; Guerin, P.M. (2004) **Tsetse flies are attracted to the invasive plant Lantana camara.** *Journal of Insect Physiology.* 50(1): 43-50. ISSN: 0022-1910.
NAL Call Number: 421 J825
Descriptors: biogeography, population studies, sense organs and sensory reception, terrestrial ecology, vector biology, *Glossina brevipalpis,* tsetse fly, Diptera, disease vector, parasite, *Glossina fuscipes fuscipes, Glossina pallidipes, Lantana camara,* antennal receptor cells, blood and lymphatics, sleeping sickness, laboratory techniques, environmental biology.

Tachibana, S.-I.; Numata, H. (2004) **Parental and direct effects of photoperiod and temperature on the induction of larval diapause in the blow fly *Lucilia sericata*.** *Physiological Entomology.* 29(1): 39-44. ISSN: 0307-6962.
NAL Call Number: QL461.P5
Descriptors: biosynchronization, climatology, development, terrestrial ecology, Diptera, *Lucilia sericata,* egg, larva, Calliphoridae, blow fly, parent feeding, larval diapause, photoperiod, rearing, seasonality, temperature, circadian rhythms, periodic cycles, environmental biology, bioclimatology and biometeorology, development, embryology, comparative study, experimental morphology, physiology, pathology.

Vanhaelen, N.; Francis, F.; Haubruge, E. (2004) **Purification and characterization of glutathione S-transferases from two syrphid flies (*Syrphus ribesii* and *Myathropa florea*).** *Comparative Biochemistry and Physiology Part B Biochemistry & Molecular Biology.* 137B(1): 95-100. ISSN: 1096-4959.
NAL Call Number: QP501.C6
Descriptors: behavior, enzymology, biochemistry and molecular biophysics, metabolism, methods and techniques, nutrition, physiology, pollution assessment control and management, terrestrial ecology, toxicology, Diptera, *Myathropa florae,* syrphid fly, hoverfly, *Syrphus ribesii,* aphidophagous, glutathione S-transferase characterization, detoxifying enzyme, isozymes, purification, organic pollutant, secondary metabolite, SDS-polyacrylamide gel electrophoresis, laboratory techniques, affinity chromatography, adaptation, comparative biochemistry and physiology, feeding behavior, habitat,

environmental biology.

2002

Blanckenhorn, W.U. (2002) **The consistency of quantitative genetic estimates in field and laboratory in the yellow dung fly.** *Genetica.* 114(2): 171-182. ISSN: 0016-6707.
NAL Call Number: 442.8 G282
Descriptors: genetics, Diptera, *Scathophaga stercoraria*, yellow dung fly, hind tibia length, skeletal system, body size, development time, diapause induction, environmental influence, genetic correlation, heritability, quantitative genetic estimates, consistency, cytogenetics, bones, joints, fasciae, connective and adipose tissue, physiology and biochemistry, comparative and experimental morphology, physiology and pathology.

Cuda, J.P.; Coon, B.R.; Dao, Y.M.; Center, T.D. (2002) **Biology and laboratory rearing of *Cricotopus lebetis* (Diptera: Chironomidae), a natural enemy of the aquatic weed *Hydrilla* (Hydrocharitaceae).** *Annals of the Entomological Society of America.* 95(5): 587-596. ISSN: 0013-8746.
NAL Call Number: 420 EN82
Descriptors: *Cricotopus lebetis*, mass rearing, Phytophagous, beneficial species, biological control, aquatic weed control, population density, survival, fecundity, Florida, Chironomidae, United States, population dynamics, freshwater environment, aquatic plant, Hydrocharitaceae, monocotyledons, angiospermae, Spermatophyta, Diptera.

Frouz, J.; Ali, A.; Lobinske, R.J. (2002) **Suitability of morphological parameters for instar determination of pestiferous midges *Chironomus crassicaudatus* and *Glyptotendipes paripes* (Diptera: Chironomidae) under laboratory conditions.** *Journal of the American Mosquito Control Association.* 18(3): 222-227. ISSN: 8756-971X.
NAL Call Number: QL536 J686
Descriptors: *Chironomus crassicaudatus*, *Glyptotendipes paripes*, laboratory study, morphology, morphometry, head, developmental stage, ectoparasite, nuisance, Florida, Chironomidae, United States, freshwater environment, Diptera.

Lobinske, R.J.; Ali, A.; Frouz, J. (2002) **Laboratory estimation of degree-day developmental requirements of *Glyptotendipes paripes* (Diptera: Chironomidae).** *Environmental entomology.* 31(4): 608-611. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: heat sum, development, egg, larva, nuisance, laboratory study, Florida, Chironomidae, United States, environmental factors, Diptera.

Reeves, W.K.; Mccullough, S.D. (2002) **Laboratory susceptibility of *Wyeomyia smithii* (Diptera: Culicidae) to *Ascogregarina taiwanensis* (Apicomplexa: Lecudinidae).** *The Journal of eukaryotic microbiology.* 49(5): 391-392. ISSN: 1066-5234.
NAL Call Number: QL366.J67
Descriptors: parasitism, protozoal disease, sensitivity resistance, larva, vector, experimental study, laboratory study, parasitosis, infection, freshwater environment, host parasite relation, Culicidae, Diptera, Apicomplexa, Protozoa.

2001

Alyokhin, A.V.; Mille, C.; Messing, R.H.; Duan, J.J. (2001) **Selection of pupation habitats by Oriental fruit fly larvae in the laboratory.** *Journal of insect behavior.* 14(1): 57-67. ISSN: 0892-7553.
NAL Call Number: QL496.J68
Descriptors: Oriental fruit fly, *Bactrocera dorsalis* (Hendel), Diptera, habitat selection, pupation, wandering larvae, pupation, pupation habitats, pest, fruit crop, soils, humidity, compactness, shading, laboratory study, Tephritidae, environmental factor, Diptera.

Shelly, T.E.; McInnis, D.O. (2001) **Exposure to ginger root oil enhances mating success of irradiated, mass-reared males of Mediterranean fruit fly (Diptera: Tephritidae).** *Journal of Economic Entomology.* 94(6): 1413-1418. ISSN: 0022-0493.
NAL Call Number: 421 J822
Abstract: Previous research revealed that exposure to ginger root oil, Zingiber officinale Roscoe, containing the known male attractant (a-copaene) increased the mating success of male Mediterranean fruit flies, *Ceratitis capitata* (Wiedemann), from a newly established laboratory colony. The goal of the current study was to determine whether exposure to ginger root oil likewise enhanced the mating competitiveness of irradiated *C. capitata* males from a 5-yr-old mass-reared strain. Mating tests were conducted in field cages containing guava trees (*Psidium guajava* l.) to monitor the mating frequency of irradiated, mass-reared and wild males competing for wild females. In the absence of chemical exposure, wild males outcompeted the mass-reared males and obtained 74% of all matings. However, following exposure to ginger root oil (20 microl for 6 h), the mating frequencies were reversed. Whether exposed as mature (3-d-old) or immature (1-d-old) adults, mass-reared males achieved approximately 75% of all matings in tests conducted 2 or 4 d following exposure, respectively. Irradiated, mass-reared males prevented from contacting the oil directly (i.e., exposed to the odor only for 6 h) still exhibited a mating advantage over wild males. In an additional study, signaling levels and female arrivals were compared between males exposed to ginger root oil and nonexposed males, but no significant differences were detected. The implications of these findings for the sterile insect technique are discussed.
Descriptors: *Ceratitis capitata*, ginger root oil exposure, Diptera physiology, sterile insect technique, flies, alpha copaene, competitiveness, courtship, behavior, ginger metabolism, pheromones, plant oils, sex behavior, plant roots, Hawaii.

2000

Armbruster, P.; R. A. Hutchinson; T. Linvell. (2000) **Equivalent inbreeding depression under laboratory and field conditions in a tree-hole-breeding mosquito.** *Proceedings of the Royal Society of London. Series B. Biological sciences.* 267 (1456): 1939-1945. ISSN: 0962-8452.
NAL Call Number: 501 L84B
Descriptors: *Aedes geniculatus*, reproduction, genotype environment interaction.

Chapman, J.W.; Goulson, D. (2000) **Environmental versus genetic influences on fluctuating**

asymmetry in the house fly, *Musca domestica*. *Biological Journal of the Linnean Society.* 70(3): 403-413. ISSN: 0024-4066.
NAL Call Number: QH301.B56
Descriptors: Diptera, *Musca domestica*, developmental stability, heritability, rearing conditions, environmental stress, temperature, density, sexual selection, metaanalysis, stress, instability, indicator, symmetry.

Gleiser, R.M.; Urrutia, J.; Gorla, D.E. (2000) **Effects of crowding on populations of *Aedes albifasciatus* larvae under laboratory conditions.** *Entomologia experimentalis et applicata.* 95(2): 135-140. ISSN: 0013-8703.
NAL Call Number: 421 En895
Descriptors: *Aedes albifasciatus*, laboratory study, development, mortality, larva, vector, Western Equine Encephalomyelitis virus, density dependence, Culicidae, Alphavirus, Togaviridae, population dynamics, environmental factor, Diptera.

Ji, W.; Yang, K.; Liu, J. (2000) **[Observation on oviposit *Musca domestica* at various temperature and humidity in laboratory (sic)].** *Chinese Journal of Parasitic Disease Control.* 13(1): 64-66. ISSN: 1001-6627, Note: In Chinese.
Descriptors: humidity, temperature, oviposition, environmental factors, *Musca domestica*, Diptera, Muscidae, public health pests, vectors and intermediate hosts, reproduction, development and life cycle.

Sacks, D.L.; G. Modi; E. Rowton; G. Spath; L. Epstein; S.J. Turco; S.M. Beverley (2000) **The role of phosphoglycans in *Leishmania*-sand fly interactions.** *Proceedings of the National Academy of Sciences of the United States of America.* 97(1): 406-411. ISSN: 0027-8424.
NAL Call Number: 500 N21P
Abstract: *Leishmania* promastigotes synthesize an abundance of phosphoglycans, either attached to the cell surface through phosphatidylinositol anchors (lipophosphoglycan, LPG) or secreted as protein-containing glycoconjugates. These phosphoglycans are thought to promote the survival of the parasite within both its vertebrate and invertebrate hosts. The relative contributions of different phosphoglycan-containing molecules in *Leishmania*-sand fly interactions were tested by using mutants specifically deficient in either total phosphoglycans of LPG alone. *Leishmania donovani* promastigotes deficient in both LPG and protein-linked phosphoglycans because of loss of LPG2 (encoding the Golgi GDP-Man transporter) failed to survive the hydrolytic environment within the early blood-fed midgut. In contrast, *L. donovani* and *Leishmania major* mutants deficient solely in LPG expression because of loss of LPG1 (involved in biosynthesis of the core oligosaccharide LPG domain) had only a slight reduction in the survival and growth of promastigotes within the early blood-fed midgut. The ability of the LPG1-deficient promastigotes to persist in the midgut after blood meal excretion was completely lost, and this defect was correlated with their inability to bind to midgut epithelial cells in vitro. For both mutants, when phosphoglycan expression was restored to wild-type levels by reintroduction of LPG1 or LPG2 (as appropriate), then the wild-type phenotype was also restored. We conclude, first, that LPG is not essential for survival in the early blood-fed midgut but, along with other secreted phosphoglycan-containing glycoconjugates, can protect promastigotes from the digestive enzymes in the gut and,

second, that LPG is required to mediate midgut attachment and to maintain infection in the fly during excretion of the digested blood meal.
Descriptors: *Phlebotomus papatasi*, *Phlebotomus argentipes*, *Leishmania donovani*, promastigotes, polysaccharides, survival, growth, midgut, binding, mutants, agglutination, blood meals.

Shelly, T.E.; S.D. McCombs; D.O. McInnis (2000) **Mating competitiveness of male oriental fruit flies from a translocation strain (Diptera: Tephritidae).** *Environmental entomology.* 29(6): 1152-1156. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Abstract: A major advance in sterile insect release programs against tephritid fruit fly pests has been the development of genetic sexing strains, which allow the production of males-only lines for field release. Genetic sexing strains both reduce the costs associated with mass rearing and enhance the mating effectiveness of sterile males. Research and application of genetic sexing strains has been limited largely to the Mediterranean fruit fly. However, translocation-based genetic sexing strains based on pupal color mutants have been constructed in the oriental fruit fly, *Bactrocera dorsalis* (Hendel). Here, we describe the results of laboratory tests on *B. dorsalis* that compared the relative success of males from a translocation-based sexing strain and wild males in mating competition for wild females. Additional tests examined the effect of irradiation and exposure to methyl eugenol on the mating frequency of males from the genetic sexing strain.
Descriptors: *Bactrocera dorsalis*, translocation lines, sex control, strains, males, mating competitiveness, mating ability, mating frequency, mating behavior, strain differences, irradiation, sterilization, sterile insect release, methyl eugenol.

Suenaga, H.; Tanaka, A.; Kamiwada, H.; Kamikado, T.; Chishaki, N. (2000) **Long-term changes in age-specific egg production of two *Bactrocera cucurbitae* (Diptera: Tephritidae) strains mass-reared under different selection regimes, with different egg collection methods.** *Applied Entomology and Zoology.* 35(1): 13-20. ISSN: 0003-6862, Notes: 1 table; 3 fig.; 27 refs.
NAL Call Number: SB599 A6
Descriptors: *Bactrocera cucurbitae*, oviposition, mass rearing, ecology, environmental factors, fertility, biological properties, Diptera, physiological functions, rearing techniques, sexual reproduction, Tephritidae.

Teng, H.J.; Apperson, C.S. (2000) **Development and survival of immature *Aedes albopictus* and *Aedes triseriatus* (Diptera: Culicidae) in the laboratory: Effects of density, food, and competition on response to temperature.** *Journal of medical entomology.* 37(1): 40-52. ISSN: 0022-2585.
NAL Call Number: 421 J828
Descriptors: laboratory study, mosquito population, ectoparasite, vector, development, survival, interspecific competition, population density, food supply, temperature, *Aedes triseriatus*, *Aedes albopictus*, population dynamics, environmental factor, Culicidae, Diptera.

1999

Viviani, A. de; Araujo-Coutinho, C. J. (1999) **Período do desenvolvimento ovarian do pertinax de Simulium kollar, 1832 (Diptera: Simuliidae) sob condições do laboratório. [Period of ovarian development of *Simulium pertinax kollar*, 1832 (Diptera: Simuliidae) under laboratory conditions].** *Entomologia y Vectores.* 6(2): 180-189. Note: In Portuguese.
Descriptors: eggs, oviposition, temperature, gonotrophic cycles, ovarian development, reproduction, life cycle, environmental factors, biology, development, aquatic insects, *Simulium pertinax*, Brazil, Sao Paulo, Hominidae, Primates, Diptera.

1998

Aguiar-Coelho, V.M.; Milward-De'Azevedo, E.M. (1998) **Combined rearing of *Cochliomyia macellaria* (Fabr.), *Chrysomya megacephala* (Fabr.) and *Chrysomya albiceps* (Wied.) (Dipt., Calliphoridae) under laboratory conditions.** *Journal of Applied Entomology.* 122(9-10): 551-554. ISSN: 0931-2048.
NAL Call Number: 421 Z36
Descriptors: ecology, methods and techniques, pest assessment control and management, Diptera, *Chrysomya albiceps*, Calliphoridae, carrion colonizer, *Chrysomya megacephala*, *Cochliomyia macellaria*, interspecific relationships, competition, larval survival, comparative and experimental morphology, physiology and pathology, environmental biology, economic entomology.

Alonso-Pimentel, H.; J.B. Korer; C. Nufio; D.R. Papaj (1998) **Role of colour and shape stimuli in host-enhanced oogenesis in the walnut fly, *Rhagoletis juglandis*.** *Physiological entomology.* 23(2): 97-104. ISSN: 0307-6962.
NAL Call Number: QL461.P5
Abstract: This study aimed to quantify effects of the host plant on oogenesis in the walnut-husk-infesting fly, *Rhagoletis juglandis cresson* (Diptera: Tephritidae), and to assess the role of physical cues in those effects. In laboratory assays, the presence of fruit was manipulated independently of the presence of foliage for newly emerged females. After eight days, in each of two trials, females with fruit were found to have significantly higher egg loads than females without fruit. Foliage presence had little effect. In a second experiment, females held with fruit or a fruit model (plastic yellow sphere of a size similar to fruit) had significantly higher egg loads than females held with neither fruit nor model. Egg loads of females with fruit were not significantly different from those of females with models. In a third experiment, females were held with spheres of various colours or no sphere at all. Females with yellow or green spheres (similar to the colour of walnut fruit) had significantly higher egg loads than females with black, blue or red spheres of other colours or females without spheres. In a fourth experiment, females held with spheres had significantly higher egg loads than females held with cubes of equivalent surface area or females held without a model. Finally, cohorts of newly emerged females held with yellow spheres or without spheres were sampled periodically. In the sphere treatment, mean egg load increased sharply from negligible levels between days 8 and 10. The pattern was similar in the no-sphere treatment, although the increase

in egg load appeared to occur a day later. From these experiments, we conclude that physical host fruit stimuli known to be important in host selection in Rhagoletis flies, including colour and shape, also enhance oogenesis in the first egg maturation cycle, and that enhancement of oogenesis via these stimuli requires neither nutritional input from the fruit nor prior egg deposition.
Descriptors: *Rhagoletis*, oogenesis, fecundity, host plants, Juglans major, fruits, models, color, shape, visual stimuli, Diptera.

Blanckenhorn, W.U. (1998) **Altitudinal differentiation in the diapause response of two species of dung flies.** *Ecological entomology.* 23(1): 1-8. ISSN: 0307-6946.
NAL Call Number: QL461.E4
Abstract: 1. Seasonality is a prime selective factor promoting genetic differentiation of populations. Local adaptation in diapause response was investigated in the two geographically and altitudinally widespread dung flies *Scathophaga stercoraria* (Diptera: Scathophagidae) and *Sepsis cynipsea* (Diptera: Sepsidae). 2. Replicate sibships from three sites in Switzerland with low and high altitude dung fly populations were raised in a common laboratory environment simulating the natural decreasing photoperiod and temperature regimen before winter. From field phenologies, the critical photoperiod inducing diapause was predicted to be longer for high than for low altitude populations (12 vs. 10 h for *Sc. stercoraria*, and 12.25 vs. 11 h for *Se. cynipsea*) if they are locally adapted. 3. Contrary to expectation and to *Sc. stercoraria*, which diapauses in the pupal stage, *Se. cynipsea* diapauses in the adult stage. 4. Low but significant levels of genetic differentiation in pre-winter adult emergence were evident between low and high altitude populations of both species, but they were far from the differences predicted. *Scathophaga stercoraria* also showed geographical differentiation independent of altitude. 5. *Sepsis cynipsea* females stopped reproducing at some point before winter, but altitude did not affect the timing of adult diapause. High altitude females and females that did not initiate reproduction before winter survived the simulated winter better. 6. Both species largely used temperature rather than photoperiod as a cue inducing winter diapause, an untypical case of phenotypic plasticity. The hypothesis that *Sc. stercoraria*, whose generation times are much longer than those of *Se. cynipsea*, responds to a greater extent to temperature rather than photoperiod only was rejected.
Descriptors: *Sepsis diptera*, *Scathophaga stercoraria*, diapause, altitude, phenotypic variation, photoperiod, adaptation, species differences, Switzerland.

Delgado Puchi, N. (1998) **Demographic parameters of the immature stages of *Anopheles aquasalis curry* 1932 (Diptera: Culicidae) under laboratory conditions.** *Boletin de Entomologia Venezolana, Serie Monografias.* 13(1): 27-43.
NAL Call Number: 421 B63
Descriptors: larvae, aquatic insects, population ecology, temperature, population density, survival, environmental factors, biological development, life cycle, rearing techniques, *Anopheles aquasalis*, Culicidae, Diptera, parasites, vectors, pathogens and biogenic diseases of humans, aquatic biology and ecology, laboratory reproduction and development, insect behavior.

Kassem, H.A. (1998) **Optimised dietary regimens for the laboratory maintenance of *Phlebotomus langeroni nitzulescu* (Diptera: Psychodidae).** *Annals of Tropical*

Medicine and Parasitology. 92(5): 615-620. ISSN: 0003-4983.
NAL Call Number: 448.9 L75A
Descriptors: *Phlebotomus langeroni*, Psychodidae, diet in captivity, optimal regimens, productivity enhancement potential, laboratory rearing techniques, pathological techniques, life cycle and development, dietary regimen relationships, comparative efficiency, Nematocera, Diptera, true flies.

Kiel, E.; Dickmann, K.; Ruehm, W. (1998) **Effects of frequent drift events on blackfly (Simuliidae, Diptera) development: a laboratory study.** *Limnologica*. 28(3): 301-305. ISSN: 0075-9511.
Descriptors: development, freshwater ecology, Diptera, *Simulium noelleri*, blackfly larva, *Simulium ornatum*, *Simulium vernum*, digestive system, drift frequency, energy expenditure, larval behavior, mortality, population dynamics, population regulation, pupation, environmental biology, limnology, energy and respiratory metabolism, comparative and experimental morphology, physiology and pathology.

Michailova, P.V.; Todorova, J. (1998) **Cytogenetic characteristics of *Glyptotendipes pallens* (Diptera, Chironomidae) reared in standard laboratory conditions.** *Cytobios*. 94(377): 151-160. ISSN: 0011-4529.
NAL Call Number: QH573.C9
Descriptors: *Glyptotendipes pallens*, Chironomidae, chromosomes, polytene chromosomes, characteristics, environmental indicators, possible use of polytene chromosome characteristics, chemical pollution, mutagens, genetics, cytogenetics, ecology, pollution, Nematocera, Diptera, true flies.

Montoya-Lerma, J.; Cadena-Pena, H.; Jaramillo-Salazar, C. (1998) **Rearing and colonization of *Lutzomyia evansi* (Diptera: Psychodidae), a vector of visceral leishmaniasis in Colombia.** *Memorias do Instituto Oswaldo Cruz*. 93(2): 263-8. ISSN: 0074-0276.
NAL Call Number: 448.9 IN74
Abstract: The sandfly *Lutzomyia evansi* from a focus of visceral leishmaniasis in northern Columbia was reared and maintained under laboratory conditions for five generations. The average time for total development was 41.9 days (range = 35.1-49.6) at 25 degrees C and 89-95% of relative humidity. The mean number of eggs laid was lower in laboratory bred females either in pots (13.2 eggs/female) or vials (29.9 eggs/female) than in wild caught females (33.4 eggs/female). Immature mortality, mainly due to fungal and mite contamination, was higher during the first two instars than in the remaining immature stages. Adults were robust and healthy although difficult to feed on hamster or chick skin membrane. In summary, *Lu. evansi* is a colonizable species but requires specific conditions.
Descriptors: *Lutzomyia evansi*, Leishmaniasis, visceral transmission TM, Psychodidae growth and development GD, Colombia, controlled environments, insect vectors, social environment, laboratory.

Petrarca, V.; G. Sabatinelli; Y.T. Toure; M.A. Di Deco (1998) **Morphometric multivariate analysis of field samples of adult *Anopheles arabiensis* and *An. gambiae s.s.* (Diptera: Culicidae).** *Journal of medical entomology*. 35(1): 16-25. ISSN: 0022-2585.
NAL Call Number: 421 J828

Abstract: The Afrotropical complex of sibling species *Anopleles gambiae giles* includes the most efficient vectors of human malaria south of the Sahara. *Anopheles arabiens* is Patton and *An. gambiae s.s. giles* are the members of the complex more adapted to the human environment. They are sympatric and synchronic over most of their distribution range; however, they show a different involvement in malaria transmission, with *An. gambiae* being more anthropophilic and endophilic than *An. arabiensis*. Discriminating between them is essential for a correct assessment of epid emiological parameters. The identification is currently achieved through recogni tion of species-specific chromosomal inversions or by molecular biology techniques. Both methods require considerable technical resources, not always available in the field. We carried out a morphometric analysis of field and laboratory samples of *An. arabiensis* and *An. gambiae* s.s. from sites in Madagascar, Burkina Fa so, Mali, and Liberia to evaluate the degree of morphological differentiation. We examined 17 morphometric characters in samples representing each of the geographic sites. All of the measures were significantly larger for *An. arabiensis* (regardless of the collection site), demonstrating an intrinsic greater body size of this species. To assess the reliability associated with the multivariate statistic, we applied the discriminant function analysis, which provided a method for predicting to which group a new case will most likely be assigned. In a blind experiment, the morphometric method correctly identified approximately 85% of fie ld-collected *An. arabiensis* and *An. gambiae s.s.*, which provided a relatively simple method to approximate the relative frequencies of the 2 species in areas in which their concurrent presence was already known. The influence of laboratory conditions on the morphometrics of the 2 species was also analyzed.
Descriptors: *Anopheles arabiensis*, *Anopheles gambiae*, morphology, identification, morphotaxonomy, multivariate analysis, discriminant analysis, adult mosquitoes.

Prokopy, R.J.; X. Hu; E.B. Jang; R.I. Vargas; J.D. Warthen (1998) **Attraction of mature *Ceratitis capitata* females to 2-heptanone, a component of coffee fruit odor.** *Journal of chemical ecology.* 24 (8): 1293-1304. ISSN: 0098-0331.
NAL Call Number: QD415.A1J6
Abstract: In indoor laboratory-cage and outdoor field-cage assays, we evaluated the attraction of released, protein-fed, mature Mediterranean fruit fly females to six volatile compounds emitted by attractive crushed ripe coffee fruit: 3-methyl-1-butanal, decanal, 3-methyl-1-butanol, 2-(Z)-pentenol, 2-(E)-hexenol, and 2-heptanone. Previous tests in a wind tunnel indicated that each of these six compounds was more attractive than clean air to females. In laboratory cage assays, none of the compounds elicited a response significantly greater than that to water. In field-cage assays, 2 or 4 microliter of 2-heptanone in 5 ml of water (but none of the other compounds at 2 or 4 microliter in 5 ml of water) consistently attracted protein-fed medflies at significant levels that averaged about five times greater than attraction to water alone, although about 40% less than attraction to odor of coffee fruit extract. All types of mature protein-fed females tested (laboratory-cultured virgin, laboratory-cultured mated, wild mated) in field-cage assays responded similarly to 2-heptanone, whereas same-age (9- to 11-day-old) protein-deprived females did not respond significantly to 2-heptanone. Response of protein-fed females to 2-heptanone increased progressively with increasing dose (1, 2, 4, or 8 microliter in 5 ml of water). Addition of 2 microliter of 2-heptanone or 2 microliter of any of the other compounds tested to 5 ml of water extract of coffee fruit did not

enhance attractiveness of the extract. Relative to response to water, protein-fed females consistently exhibited a significant positive response to odor of coffee fruit extract but no significant response to odor of Nulure (a proteinaceous food attractant). Together, our findings suggest that mature protein-fed females were responding to 2-hep-tanone as though it were an oviposition-site stimulus rather than a feeding-site stimulus.
Descriptors: *Ceratitis capitata*, protein-fed Mediterranean fruit flies, insect attractants, volatile compounds, ketones, aldehydes, alcohols, plant composition, responses, bioassays, field experimentation, Diptera, 2-heptanone.

1997

Chadee, D.D.; Beier, J.C. (1997) **Factors influencing the duration of blood-feeding by laboratory-reared and wild *Aedes aegypti* (Diptera: Culicidae) from Trinidad, West Indies.** *Annals of Tropical Medicine and Parasitology.* 91(2): 199-207. ISSN: 0003-4983.
NAL Call Number: 448.9 L75A
Descriptors: diet, size, nutrition, environmental factors, hematophagy, feeding behavior, *Aedes aegypti*, Trinidad and Tobago, Culicidae, Diptera, developing countries, ACP countries, parasites, vectors, pathogens and biogenic diseases of humans, wild and captive mosquitoes.

Dutta, P.; Sharma, C.K.; Khan, S.A.; Mahanta, J. (1997) **Laboratory colonization and maintenance of *Toxorhynchites splendens* (Diptera: Culicidae) with a note on its larval preying capacity.** *Entomon.* 22(1): 51-54. ISSN: 0377-9335.
NAL Call Number: QL461.E6
Descriptors: life history, predation, larvae, aquatic insects, environmental factors, temperature, humidity, ecology, rearing techniques, *Toxorhynchites splendens*, *Culex quinquefasciatus*, Culicidae, Diptera, behavior, parasites, vectors, pathogens and biogenic diseases of humans.

Jang, E.B.; Carvalho, L.A.; Stark, J.D. (1997) **Attraction of female Oriental fruit fly, *Bactrocera dorsalis*, to volatile semiochemicals from leaves and extracts of a nonhost plant, panax (*Polyscias guilfoylei*) in laboratory and olfactometer assays.** *Journal of Chemical Ecology.* 23(5): 1389-1401. ISSN: 0098-0331.
NAL Call Number: QD415.A1J6
Descriptors: behavior, biochemistry and molecular biophysics, ecology, economic entomology, endocrine system, chemical coordination and homeostasis, physiology, Diptera, *Bactrocera dorsalis*, *Polyscias guilfoylei*, analytical method, chemical ecology, panax, fruit fly control, kairomones, males and females, olfactometer, oriental fruit fly, pests, semiochemicals, behavioral biology, environmental biology, comparative and experimental morphology, physiology and pathology.

Layne, J.R. Jr.; R.E. Medwith (1997) **Winter conditioning of third instars of the gall fly *Eurosta solidaginis* (Diptera: Tephritidae) from western Pennsylvania.** *Environmental entomology.* 26 (6): 1378-1384. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Abstract: Third instars of *Eurosta solidaginis* (Fitch) inhabit stem galls on goldenrod,

Solidago spp., exposing them to cold, desiccation, and temperature instability. Because these conditions increase the risk of metabolic stress, the physiological conditioning of 3rd instars was examined between September and March for 2 successive years (1993-1994 and 1994-1995). The maximum and minimum air temperatures differed by 63 and 50 degrees C during 1993-1994 and 1994-1995, respectively. Subnormal temperatures prevailed most of the winter for 1993-1994, whereas an opposite trend existed during 1994-1995. Although subfreezing temperatures were still common during both years, temperatures were often above the larval supercooling point. The water content of larvae was stable throughout the study but their body mass and lipid content declined nearly 20% during each study period. Hemolymph osmolality rose from 0.5 Osmoles (September) to just above 1.3 Osmoles (January). The supercooling point rose from -11.4 to -9.8 degrees C between September and October; it then remained stable until declining in March. Some changes seen here (e.g., reducing supercooling capacity) likely facilitate the winter survival of the larvae; whereas, other physiological changes (e.g., loss of stored lipids) represent passive responses to the harsh gall environment. Moderate differences in winter severity between the 2 yr failed to appreciably alter larval use of energy reserves or their maintenance of cryoprotectant levels.
Descriptors: *Eurosta solidaginis*, larvae, overwintering, cold hardening, cold resistance, hemolymph, body weight, osmotic pressure, water content, lipids, bioenergetics, environmental temperature, seasonal variation, temporal variation, Pennsylvania.

Miyatake, T. (1997) **Genetic trade-off between early fecundity and longevity in *Bactrocera cucurbitae* (Diptera: Tephritidae).** *Heredity.* 78(1): 93-100. ISSN: 0018-067X.
NAL Call Number: 443.8 H42
Descriptors: *Bactrocera cucurbitae*, fecundity, longevity, pleiotropy, selection, trade off, bean weevil *Acanthoscelides obtectus*, term, laboratory evolution, *Drosophila melanogaster*, life history, bean weevil, environmental variation, artificial selection, late reproduction, melon fly, fitness.

Nieves, E.; Ribeiro, A.; Brazil, R. (1997) **Physical factors influencing the oviposition of *Lutzomyia migonei* (Diptera: Psychodidae) in laboratory conditions.** *Memorias do Instituto Oswaldo Cruz.* 92(6): 733-737. ISSN: 0074-0276.
NAL Call Number: 448.9 IN74
Descriptors: *Lutzomyia migonei*, Psychodidae, egg laying, oviposition, effect of physical factors, habitat, substrate effect on oviposition, spatial environment, physical space effect on oviposition, laboratory study, reproduction, habitat, abiotic factors, physical factors, Psychodidae, Nematocera, Diptera, true flies.

Purnomo, S.; Handoko; Budijono, A.L. (1997) **Effect of environment and kind of feeds on rearing insect pollinator of mango (*Mangifera indica l.*) flower.** *Jurnal Hortikultura.* 7(2): 622-630. ISSN: 0853-8097. Notes: 3 ill., 7 tables; 13 ref., In Indonesian.
NAL Call Number: SB317.56 I5J87
Abstract: Pollinator insect played an important role in increasing fruitset in mango Arumanis cultivar, but the population was relatively low at the time of blooming. The aim of this research was to determine and rear those pollinator insects. Result showed that pollinator insects that was previously grouped into *Syrphus* sp., in fact was *Calliphora erythrocephala l.*, with popular name langau, having life cycle from egg,

larvae, pre-pupa, pupa, and imago around 21 days. At Cukurgondang experimental garden with relative humidity less than 68.7 percent and temperature at 29-33 deg. C during dry season using rotten beef medium placed on watered soil-surface was good condition for langau reproduction where ten pairs of the langau produced 238 young male langau. Higher humidity above 68.7 percent with < 21,5 deg. C daily temperature as at Indrokilo Experimental Farm, Malang produced higher numbers of langau i.e. 1638-2647 young langaus. Artificial environment especially relative humidity < 68.7 percent and daily temperature 21.5 deg. C and food of decayed fish could speed up the rearing of *C. erythrocephala* to aid the mango fruit fertilization. The suitable environment in the field can be arranged before blooming, then followed by organic fertilizer application originated from decayed fish or garbage and watering the soil until field capacity.
Descriptors: *Mangifera indica*, environment, feeds, rearing techniques, pollinators, *Calliphora erythrocephala*, life cycle, Calliphoridae, Diptera, useful insects.

Reisen, W.K.; J.L. Hardy; S.B. Presser (1997) **Effects of water quality on the vector competence of *Culex tarsalis* (Diptera: Culicidae) for western equine encephalomyelitis (Togaviridae) and St. Louis encephalitis (Flaviviridae) viruses.** *Journal of medical entomology*. 34(6): 631-643. ISSN: 0022-2585.
NAL Call Number: 421 J828
Abstract: The effects of water quality during immature development on the vector competence of adult female *Culex tarsalis coquillett* for western equine encephalomyelitis (WEE) and St. Louis encephalitis (SLE) viruses was evaluated during 6 field and 4 laboratory experiments. Immatures of the Bakersfield Field Station laboratory strain and the F1 progeny of field-collected females were reared in the field or laboratory and then infected by feeding on pledgets, after which remnants (head, thorax, abdomen), legs, and salivary secretions were tested for WEE or SLE virus to estimate infection, dissemination, and transmission rates, respectively. Although the salt content of the 6 larval habitats varied markedly (range, alkalinity 160-1,310 ppm CaCO3, conductivity 460-7,600 micromhos/cm, chlorides 22-1,560 ppm) and significantly altered immature survival, development time, and female body size (wing length), consistent changes in infection, dissemination, or transmission rates were not observed. Susceptibility (ID50) to WEE virus in field strains decreased as a linear function of developmental time, with populations from a dry alkali lake bed (Goose Lake) least susceptible. Three subsequent laboratory experiments that tested the effects of rearing immatures in dilution series of water from Goose Lake failed to produce consistent within or among experiment patterns in vector competence. A 4th laboratory experiment tested changes in NaCl concentration with negative results. Changes in female size was not related to vector competence. These and previous temperature studies indicated that temporal changes in vector competence observed within and among field populations probably were related to intrinsic genetic factors and were not related directly to extrinsic factors in the immature aquatic environment.
Descriptors: *Culex tarsalis*, western equine encephalitis virus, St. Louis encephalitis virus, mosquito vector competence, disease transmission, larvae, habitats, water quality, salinity, NaCl, biological development, survival, size, California.

Sibley, P.K.; Benoit, D.A.; Ankley, G.T. (1997) **Life cycle and behavioral assessments of the influence of substrate particle size on *Chironomus tentans* (Diptera: Chironomidae)**

in laboratory assays. *Hydrobiologia.* 361(8): 1-9. ISSN: 0018-8158.
NAL Call Number: 410 H992
Descriptors: freshwater ecology, Diptera, *Chironomus tentans*, behavioral assessments, development, emergence, growth, life cycle, reproduction, substrate particle size, survival, environmental biology, behavioral biology, comparative and experimental morphology, physiology and pathology.

Trexler, J.D.; Apperson, C.S.; Schal, C. (1997) **Diel oviposition patterns of *Aedes albopictus* (Skuse) and *Aedes triseriatus* (Say) in the laboratory and the field.** *Journal of Vector Ecology.* 22(1): 64-70. ISSN: 1081-1710.
NAL Call Number: RA639.S63
Descriptors: biosynchronization, mosquito ecology, physiology, reproductive system, Diptera, *Aedes albopictus*, *Aedes triseriatus*, diel periodicity, oviposition, circadian rhythms and other periodic cycles, environmental biology, comparative and experimental morphology, physiology and pathology.

Wells, J.D.; Kurahashi, H. (1997) ***Chrysomya megacephala* (Fabr.) is more resistant to attack by *Ch. rufifacies* (Macquart) in a laboratory arena than is *Cochliomyia macellaria* (Fabr.) (Diptera: Calliphoridae).** *Pan Pacific Entomologist.* 73(1): 16-20. ISSN: 0031-0603.
NAL Call Number: 421 P193
Descriptors: behavior, ecology, environmental biology, morphology, Diptera, *Chrysomya megacephala*, *Chrysomya rufifacies*, *Cochliomyia macellaria*, abundance, competitive displacement, larva, predator, comparative and experimental morphology, physiology and pathology.

1996

Aguiar-Coelho, V.M.; Milward-De-Azevedo, E.M. (1996) **Association between *Chrysomya megacephala* (Fabricius) and *Chrysomya albiceps* (Weidemann), *Chrysomya megacephala* (Fabricius) and *Cochliomyia macellaria* (Fabricius) larvae (Calliphoridae, Diptera), under laboratory conditions.** *Revista Brasileira de Zoologia.* 12(4): 991-1000. ISSN: 0101-8175. Note: In Portuguese.
NAL Call Number: QL242 R48
Descriptors: development, ecology, nutrition, physiology, Diptera, *Chrysomya albiceps*, *Chrysomya macellaria*, *Chrysomya megacephala*, *Cochliomyia macellaria*, development, diet, predation, environmental biology, nutritional status and methods, developmental biology, embryology, morphogenesis, comparative and experimental morphology, physiology and pathology.

Beck, M.; Ludwig, M.; Becker, N. (1996) **Impact of microorganisms and water quality on the efficacy of *Bacillus sphaericus neide* against *Culex pipiens* larvae in the laboratory.** *Journal of vector ecology.* 21(1): 26-30. ISSN: 1081-1710.
NAL Call Number: RA639.S63
Descriptors: bacteria, water quality, pathogenicity, microbiological control, vector, microorganism relation, laboratory study, *Bacillus sphaericus*, *Culex pipiens*, environmental factor, Diptera.

Blackwell, A.; P.S. Mellor; W. Mordue (1996) **Methods for enhancing the blood feeding response of field-collected *Culicoides impunctatus* (Diptera: Ceratopogonidae).** *Journal of medical entomology.* 33(3): 504-506. ISSN: 0022-2585.
NAL Call Number: 421 J828
Abstract: Handling methods were found to lengthen the time after capture that *Culicoides impunctatus goetghebuer* could be blood fed successfully in the laboratory using an artificial membrane technique. By maintaining high levels of humidity in holding cages kept in a cool, dark environment, > 30% feeding success was achieved 72 h after capture, when feeding was carried out at low light conditions.
Descriptors: *Culicoides impunctatus*, laboratory rearing, rearing techniques, membrane feeding, humidity, environmental temperature, light.

Bonatto, S.R. (1996) **Life cycle of *Sarconesia chlorogaster* (Wiedemann) (Diptera, Calliphoridae, Toxotarsinae), reared under laboratory conditions on artificial diet.** *Revista Brasileira de Zoologia.* 13(3): 685-706. ISSN: 0101-8175. Note: In Portuguese.
NAL Call Number: QL242 R48
Descriptors: ecology, nutrition, physiology, Diptera, Calliphoridae, *Sarconesia chlorogaster*, artificial diet, bionomics, economic entomology, life cycle, environmental biology, nutrition, nutritional status and methods, comparative and experimental morphology, physiology and pathology.

Chin-Chang, Y.; Yi-Yuan, C. (1996) **Colonization and bionomics of *Forcipomyia taiwana* (Diptera: Ceratopogonidae) in the laboratory.** *Journal of medical entomology.* 33(3): 445-448. ISSN: 0022-2585.
NAL Call Number: 421 J828
Descriptors: blood sucking, nuisance, insects, life history, development, temperature, diet, mating, swarming, laboratory study, rearing, Ceratopogonidae, environmental factor, reproduction, Diptera.

Collier, R.H.; Finch, S. (1996) **Field and laboratory studies on the effects of temperature on the development of the carrot fly (*Psila rosae f.*).** *Annals of Applied Biology.* 128(1): 1-11. ISSN: 0003-4746.
NAL Call Number: 442.8 AN72
Descriptors: climatology, economic entomology, horticulture, physiology, *Psila rosae*, biobusiness, carrot fly, field conditions, laboratory conditions, ecology, environmental biology, bioclimatology and biometeorology, temperature as a primary variable, developmental biology, embryology, morphogenesis, comparative and experimental morphology, pathology, Diptera.

D'Almeida, J.M.; Almeida, J.R. (1996) **Longevity and survivorship curves of eight species of the calyptrate flies (Calliphoridae, Muscidae and Sarcophagidae) under laboratory conditions in Rio de Janeiro.** *Revista Brasileira de Biologia.* 56(3): 497-505. ISSN: 0034-7108.
NAL Call Number: 442.8 R326
Descriptors: aging, ecology, physiology, Diptera, *Atherigona orientalis*, Calliphoridae, *Chrysomya megacephala*, *Chrysomya putoria*, Muscidae, *Parasarcophaga ruficornis*, *Peckia chrysostoma*, *Phaenicia cuprina*, *Ravinia belforti*, Sarcophagidae, *Synthesiomyia*

nudiseta, Brazil, South America, Neotropical region, female, life expectancy, longevity, male, Rio de Janeiro, survivorship, zoology, environmental biology, gerontology, comparative and experimental morphology, physiology and pathology.

Fouque, F.; J. Baumgartner (1996) **Simulating development and survival of *Aedes vexans* (Diptera: Culicidae) preimaginal stages under field conditions.** *Journal of medical entomology.* 33(1): 32-38. ISSN: 0022-2585.
NAL Call Number: 421 J828
Abstract: Ecology and population dynamics of *Aedes vexans* (Meigen), were studied for 3 yr in southern Switzerland. Demographic data were compiled into single and multicohort stage-frequency lifetables that indicated variability in individual developmental times and losses caused by mortality. The structure of life table matrices suggested an analysis using a timevarying distributed delay model with attrition. Field data then were used to construct and validate a simulation model that input the number of 1st instars and output the number of emerging adults. The delay was the time required to complete development and attrition corresponded to mortality. Under optimal food supply, temperature was the most important driving variable. The model was parameterized with data obtained from laboratory experiments and evaluated with field data. Development and survival of preimaginal *Ae. vexans* were simulated reasonably well under 2 different pool habitats. Addition of a hydrology component to the model would enhance control operations by predicting hatch rates in the field.
Descriptors: *Aedes vexans*, biological development, survival, mosquito mortality, life tables, simulation models, population dynamics and ecology, environmental temperature, Switzerland.

Grossman, G.A.; Lourenco-de-Oliveira, R. (1996) **Observations on the emergence, longevity, blood feeding and oviposition behavior of *Culex saltanensis dyar* in the laboratory (Diptera, Culicidae).** *Revista Brasileira de Entomologia.* 40(3/4): 357-365. ISSN: 0085-5626.
NAL Call Number: 421 R3292
Descriptors: mosquito life cycle, feeding preferences, emergence, longevity, oviposition, behavior, breeding places, horse dung, salt tolerance, survival, environmental factors, ecology, biological development, biology, development, feeding, poultry, *Culex saltanensis*, toads, *Bufo*, fowls, Brazil, Rio de Janeiro, *Gallus gallus*, Phasianidae, Galliformes, birds, Brazil, parasites, vectors, pathogens.

Marchiori, C.H.; Prado, A.P. (1996) **Effect of the temperature on the development of the immature stages of *Fannia pusio* (Wiedemann, 1830) (Diptera: Fanniidae) in laboratory.** *Revista Brasileira de Biologia.* 56(1): 93-98. ISSN: 0034-7108. Note: In Portuguese.
NAL Call Number: 442.8 R326
Descriptors: life cycle, temperature, environmental factors, eggs, ova, larvae, pupae, heat sums, biology, development, *Fannia pusio*, Brazil, Sao Paulo, Diptera, South America, insect reproduction, public health, insect pests.

Nunamaker, R.A.; V.C. Dean; K.E. Murphy; J.A. Lockwood (1996) **Stress proteins elicited by cold shock in the biting midge, *Culicoides variipennis sonorensis wirth* and *jones.***

Comparative biochemistry and physiology. Part B, Biochemistry and molecular biology. 113B(1): 73-77.
NAL Call Number: QP501.C6
Abstract: In vivo protein expression in the abdominal viscera of *C. v. sonorensis* was examined from adult flies that were cold shocked for various lengths of time at 0, -10, or -15 degrees C and labelled at 25 degrees C with 35S-methionine at 0, 2, 4 and 6 hr during the recovery period. In vitro labelling showed that seven unique proteins (23, 40, 43, 48, 60, 70 and 92 kDa) were produced in (*C. v. sonorensis* exposed to low temperatures in vivo. In general, the rate of expression and quality of stress proteins were directly proportional to both the severity and duration of the cold shock. A polyclonal antibody to the moth hsp 60/63 crossreacted with antigen from the viscera of the 60 kDa protein that was expressed during recovery from cold shock. This crossreaction with *C. v. sonorensis* suggests that the 60 kDa protein expressed during recovery from cold shock in the midge is immunologically related to the moth heat shock protein (hsp). Weather records from central Wyoming suggest that if the stress proteins produced by *C. v. sonorensis* enhance survival of the earliest, normally lethal temperatures (e.g., -5 degrees C), populations of these insects can persist for an additional 20-30 d in an average year and thus extend the time they can transmit bluetongue virus.
Descriptors: *Culicoides variipennis*, digestive system, cold shock, insect stress proteins, temperature, antibodies, cross reaction, heat shock proteins, Diptera.

Ottenheim, M.M.; A.D. Volmer; G.J. Holloway (1996) **The genetics of phenotypic plasticity in adult abdominal colour pattern of *Eristalis arbustorum* (Diptera: Syrphidae).** *Heredity.* 77(5): 493-499. ISSN: 0018-067X.
NAL Call Number: 443.8 H42
Abstract: The abdominal colour pattern of *Eristalis arbustorum* is a plastic character which is heavily influenced by developmental temperature. The present study investigated the form of the reaction norms of amount of abdominal yellow and intensity of the yellow (measured as grey value) on pupal development temperature. The slope of the reaction norm for amount of yellow was steeper in males than in females. The reaction norms for grey value on temperature were nonlinear. Family groups were reared to enable a consideration of the genetics to be made. There were significant family by environment interactions for both characters for both sexes indicating genetic variance for plasticity. Pupal development time is closely correlated with developmental temperature. The relationship between amount of yellow on the abdomen and log pupal development time was curvilinear and fitted a guadratic function well. There was significant among-family variation in the slopes of these lines for females, but not for males, again suggesting genetic variation for plasticity. The results are discussed in relation to the maintenance of genetic variation.
Descriptors: *Eristalis*, genetic variation, phenotypic variation, abdomen, color patterns, air temperature, environmental temperature, pupae, biological development, genotype environment interaction, genetic variance, male and females.

Pino, G.A.; Garrido, V.A. (1996) **Evaluation of oviposition of *Ceratitis capitata wied.*, under variable temperatures at field and constant in laboratory.** *Boletin de Sanidad Vegetal.* 22(2): 401-410. ISSN: 0213-6910. Notes: 7 fig., 5 cuadros; 20 ref., In Spanish.
NAL Call Number: SB950 A1S7

Descriptors: *Ceratitis capitata*, oviposition, fertility, temperature, field and laboratory experimentation, biological properties, Diptera, environmental factors, physiological functions, sexual reproduction, Tephritidae.

Queiroz, M.M. de C. (1996) **Temperature requirements of *Chrysomya albiceps* (Wiedemann, 1819) (Diptera, Calliphoridae) under laboratory conditions.** *Memorias do Instituto Oswaldo Cruz.* 91(6): 785-788. ISSN: 0074-0276.
NAL Call Number: 448.9 IN74
Descriptors: temperature, life cycle, environmental factors, larvae, puparia, development, *Chrysomya albiceps*, Brazil, Rio de Janeiro, Calliphoridae, Diptera, developing countries, Latin America, South America, threshold countries, public health and nuisance pests, reproduction and development, behavior.

Sheu, H.; Yeh, C.; Wang, C. (1996) **A laboratory colonization of *Anopheles sinensis wiedemann* (Diptera: Culicidae) and its life history.** *Chinese Journal of Entomology.* 16(4): 231-242. ISSN: 0258-462X. Note: In Chinese.
NAL Call Number: QL461 C465
Descriptors: mosquitoes, swarming, egg hatchability, life history, aquatic insects, larvae, temperature, environmental factors, oviposition, fecundity, size, life cycle, pupae, eggs, ova, hematophagy, feeding, blood, insemination, biology, development, rearing techniques, reproduction, gonotrophic cycles, pupation, cattle, *Anopheles sinensis*, Diptera, parasites, insect vectors.

Takagi, M.; Maruyama, K.; Sugiyama, A. (1996) **A laboratory experiment on the larval development of *Culex tritaeniorhynchus* (Diptera: Culicidae) *giles* under different temperatures and densities.** *Tropical Medicine.* 38(2): 69-77. ISSN: 0385-5643.
Descriptors: mosquito development, ecology, nutrition, physiology, Diptera, *Culex tritaeniorhynchus*, Culicidae, density effects, development, food competition, larval development, temperature effects, environmental biology, developmental biology, embryology, morphogenesis, comparative factors.

Yeh, C.; Chuang, Y. (1996) **Colonization and bionomics of *Forcipomyia taiwana* (Diptera: Ceratopogonidae) in the laboratory.** *Journal of Medical Entomology.* 33(3): 445-448. ISSN: 0022-2585.
NAL Call Number: 421 J828
Descriptors: mosquitoes, life cycle, swarming, mating, diets, larvae, temperature, environmental factors, mating behavior, laboratory rearing techniques, biology, development, *Forcipomyia taiwana*, Taiwan, Ceratopogonidae, Diptera, parasites, insect vectors.

1995

Eisemann, C.H. (1995) **Orientation by gravid Australian sheep blowflies, *Lucilia cuprina* (Diptera: Calliphoridae), to fleece and synthetic chemical attractants in laboratory bioassays.** *Bulletin of entomological research*. 85(4): 473-477. ISSN: 0007-4853.
NAL Call Number: 421 B87
Descriptors: laboratory study, attractants, nuisance insects, wool, fleece, volatile

compound, humidity, *Lucilia cuprina*, environmental factors, Calliphoridae, Diptera.

Hamburger, K.; Dall, P.C.; Lindegaard, C. (1995) **Effects of oxygen deficiency on survival and glycogen content of *Chironomus anthracinus* (Diptera, Chironomidae) under laboratory and field conditions.** *Hydrobiologia.* 297(3): 187-200. ISSN: 0018-8158.
NAL Call Number: 410 H992
Descriptors: biochemistry and molecular biophysics, development, ecology, freshwater ecology, metabolism, physiology, Diptera, *Chironomus anthracinus*, oxygen, glycogen, Denmark, anaerobic metabolism, growth, Lake Esrom, larvae, environmental biology, limnology, energy and respiratory metabolism, embryology, morphogenesis, comparative study, biochemical studies, carbohydrates.

Hunt, G.J.; Tabachnick, W.J. (1995) **Cold storage effects on egg hatch in laboratory-reared *Culicoides variipennis sonorensis* (Diptera: Ceratopogonidae).** *Journal of the American Mosquito Control Association.* 11(3): 335-338. ISSN: 8756-971X.
NAL Call Number: QL536 J686
Descriptors: cold zones, sublethal effects, hatching, temperature effects, environmental factors, eggs, cold storage, *Culicoides variipennis sonorensis*, Ceratopogonidae, Diptera, parasites, insect vectors.

Kim, Y.; E.S. Krafsur (1995) **In vivo and in vitro effects of 20-hydroxyecdysone and methoprene on diapause maintenance and reproductive development in *Musca autumnalis*.** *Physiological entomology.* 20(1): 52-58. ISSN: 0307-6962.
NAL Call Number: QL461.P5
Abstract: Face flies overwinter as adults in reproductive diapause. Administration of 20-hydroxyecdysone and/or methoprene induced reproductive development in diapausing flies which were maintained in a diapause-inducing environment. Hormone effects were additive and female flies were more sensitive than males. Release of vitellogenin from cultured fat body was stimulated by 20-hydroxyecdysone or methoprene. Transfer of flies from diapause to diapause-breaking environments induced some to break diapause, but this decreased with the time flies had been in a diapause-inducing environment. In contrast, topical application of methoprene to diapausing flies induced reproductive development irrespective of their ages even when they were kept in the diapause-inducing environment for 80 day degrees above a 12 degrees C base temperature (14.5 days). Therefore diapause induction must depend on hormone levels less than some threshold level. The putative threshold varied according to diapause propensities of different genetic lines. Lines showing high frequencies of diapause required greater amounts of methoprene for reproductive development in diapause conditions than did lines showing low frequencies of diapause.
Descriptors: *Musca autumnalis*, face fly strains, ecdysterone, injection, methoprene, topical application, application rates, biological development, diapause, sex differences, vitellogenins, fat body, genetic variation, Diptera.

Manojlovic, B.; Sivcev, I.; Zabel, A.; Kostic, M. (1995) **Duration of *Cheilosia corydon* (*harris*) (Diptera: Syrphidae) embrional development in laboratory conditions.** *Zastita Bilja.* 46(1)(211): 63-68. ISSN: 0372-7866.
NAL Call Number: 464.8 Z1

Descriptors: *Cheilosia corydon*, Syrphidae, reproductive productivity, developmental duration and success, environmental influences, abiotic factors, life cycle, Syrphidae, Cyclorrhapha, Brachycera, Diptera, true flies.

Ottenheim, M.M.; Holloway, G.J. (1995) **The effect of diet and light on larval and pupal development of laboratory-reared *Eristalis arbustorum* (Diptera: Syrphidae).** *Netherlands Journal of Zoology*. 45(3-4): 305-314. ISSN: 0028-2960.
NAL Call Number: 410 AR27
Descriptors: behavior, development, ecology, nutrition, physiology, Diptera, *Eristalis arbustorum*, vitamin C, adult body weight, crowding effect, dietary yeast, food competition, immature, light intensity, behavioral biology, environmental biology, nutritional status and methods, developmental biology, embryology, morphogenesis, comparative and experimental morphology, physiology and pathology, biochemical studies, vitamins.

Patrican, L.A.; Vaidyanathan, R. (1995) **Arthropod succession in rats euthanized with carbon dioxide and sodium pentobarbital.** *Journal of the New York Entomological Society*. 103(2): 197-207. ISSN: 0028-7199.
NAL Call Number: 420 N48J
Descriptors: biochemistry and molecular biophysics, forensics, physiology, Diptera, Muridae, Rodentia, Calliphoridae, carbon dioxide, sodium pentobarbital, forensic entomology, general biology, biochemical studies, comparative and experimental morphology, pathology.

1994

Amalraj, D.D.; Das, P.K. (1994) **Population interaction of *Toxorhynchites splendens* and *Aedes aegypti* (Diptera: Culicidae) in the laboratory.** *Southeast Asian Journal of Tropical Medicine and Public Health*. 25(4): 752-754. ISSN: 0125-1562.
NAL Call Number: RC960.S6
Descriptors: biosynchronization, ecology, economic entomology, physiology, reproductive system, vector biology, Diptera, *Aedes aegypti*, *Toxorhynchites splendens*, breeding habitat, life cycle, predator-prey interaction, circadian rhythms and other periodic cycles, environmental biology, physiology and biochemistry, economic entomology, comparative and experimental morphology, pathology.

Amoudi, M.A.; Diab, F.M.; Abou-Fannah, S.S. (1994) **Development rate and mortality of immature *Parasarcophaga (liopygia) ruficornis* (Diptera: Sarcophagidae) at constant laboratory temperatures.** *Journal of Medical Entomology*. 31(1): 168-170. ISSN: 0022-2585.
NAL Call Number: 421 J828
Descriptors: mortality, temperature, environmental factors, life cycle, biology, development, Sarcophaga, *Parasarcophaga liopygia ruficornis*, Diptera, public health and nuisance pests, behavior, insect reproduction and development, medical and veterinary entomology records.

Bravo, I.S.; Alves, M.A.; Zucoloto, F.S.; Andrade, L.A. (1994) **Aspects on alimentation and**

rearing of *Bradysia hygida sauaia* and *alves* (Diptera, Sciaridae) in laboratory. *Revista Brasileira de Zoologia*. 10(2): 343-353. ISSN: 0101-8175.
NAL Call Number: QL242 R48
Descriptors: development, ecology, nutrition, physiology, Diptera, habitat, larvae, environmental biology, nutritional status and methods, developmental biology, embryology, morphogenesis, comparative and experimental morphology, pathology.

Burgess-Cassler, A.; S.H. Imam; M.P. Kinney (1994) **Microbial alpha-amylases from pond larvae attached to starch-plastic films.** *Biotechnology letters.* 16(6): 565-568. ISSN: 0141-5492.
NAL Call Number: QR53.B56
Abstract: Starch-containing plastic films exposed to a natural freshwater environment were shown previously to undergo significant depletion of the starch components. The culture media from a number of starch-hydrolyzing bacteria that had been collected from larvae attached to these films were found to have alpha-amylase activity. Levels of amylase activity increased with culture age. Most of the activity was found to be cell-associated, and correlated on starch zymograms with an activity at about 55 kDa, in the >50% ammonium sulfate fractionation sample. The pH optimum for these amylases was just at or slightly above neutral, with a temperature optimum of about 65 degrees C.
Descriptors: Diptera, larvae, freshwater environment, bacteria, alpha amylase, plastic film, enzyme activity.

Chadee, D.D. (1994) **The life table characteristics of a laboratory population of *Culex quinquefasciatus say*, the vector of bancroftian filariasis.** *Bulletin of the Society for Vector Ecology*. 19(2): 121-124. ISSN: 0146-6429.
NAL Call Number: RA639 S63
Descriptors: mosquitoes biosynchronization, development, ecology, pathology, physiology, Diptera, Nematoda, Aschelminthes, Helminthes, *Culex quinquefasciatus*, developmental mortality, fecundity, life cycle, vector control program, circadian rhythms and other periodic cycles, environmental biology, necrosis, developmental biology, embryology, morphogenesis, comparative and experimental morphology, disinfection and vector control, parasitology.

Grabner, M.; Z. Wang; J. Mitterdorfer; F. Rosenthal; P. Charnet; A. Savchenko; S. Hering; D. Ren; L.M. Hall; H. Glossmann (1994) **Cloning and functional expression of a neuronal calcium channel beta subunit from house fly (*Musca domestica*).** *The Journal of biological chemistry*. 269(38): 23668-23674. ISSN: 0021-9258.
NAL Call Number: 381 J824
Abstract: The primary structure of a calcium channel beta subunit (betaM) from housefly (*Musca domestica*) has been deduced by cDNA cloning and sequence analysis. The open reading frame encodes a 441-amino acid polypeptide with a calculated molecular mass of 48,755 Da. Whole-mount in situ hybridization indicates that betaM mRNA is predominantly expressed in neuronal tissues. Transcription of betaM mRNA is evident from stage 13/14 of embryogenesis up to adulthood. Different expression patterns of splice variants were found in larvae and in adult fly heads. Amino acid identity between betaM and mammalian beta subunits is lower (66-68%) than within mammalian beta subunits (74-80%). Calculation of a phylogenetic tree indicates that betaM is an ancestral

form of the four distinct beta subunit gene products identified in mammalian tissues so far. Despite these sequence differences, betaM is able to enhance endogenous calcium channel activity in Xenopus laevis oocytes as well as dihydropyridine binding to membranes from COS 7 cells transfected with rabbit heart alpha 1 cDNA in the same manner as was previously shown for mammalian beta subunits.
Descriptors: *Musca domestica*, house flies, calcium ions, transport processes, genes, complementary DNA, cloning, nucleotide sequences, amino acid sequences.

Gravel, M.E.; Juliano, S.A. (1994) **Effects of laboratory selection due to predation by Toxorhynchites rutilus on size at and time to metamorphosis of the tree hole mosquito *Aedes triseriatus*.** *Bulletin of the Ecological Society of America.* 75(2-2): 79. ISSN: 0012-9623. Note: Meeting abstract, 79th Annual Meeting of the Ecological Society of America. Knoxville, Tennessee, USA. August 7-11, 1994.
NAL Call Number: 410.9 EC7
Descriptors: mosquitoes development, ecology, economic entomology, genetics, morphology, nutrition, physiology, Diptera, *Aedes triseriatus*, *Toxorhynchites rutilus*, meeting abstract, phenotypic plasticity, predation, genetics and cytogenetics, environmental biology, nutrition, general dietary studies, developmental biology, embryology, morphogenesis, comparative study.

Helleck, A.M.; Hartberg, W.K.; Vodopich, D. (1994) **Daily survivorship and life span of the mosquito *Eretmapodites quinquevittatus theobald* (Diptera: Culicidae) under laboratory conditions compared to *Aedes aegypti*, *Aedes albopictus* and *Aedes bahamensis*.** *Bulletin of the Society for Vector Ecology.* 18(2): 109-113. ISSN: 0146-6429.
NAL Call Number: RA639 S63
Descriptors: mosquitoes, blood and lymphatics, transport and circulation, ecology, economic entomology, nutrition, physiology, reproductive insect, vector biology, Diptera, *Aedes aegypti*, *Aedes albopictus*, *Aedes bahamensis*, *Eretmopodites quinquevittatus*, blood feeding, populations, environmental biology, reproductive system, physiology and biochemistry, public health, disease vectors, comparative study.

Hoffman, E.R.; Fisher, S.W. (1994) **Comparison of a field and laboratory-derived population of *Chironomus riparius* (Diptera: Chironomidae): biochemical and fitness evidence for population divergence.** *Journal of Economic Entomology.* 87(2): 318-325. ISSN: 0022-0493.
NAL Call Number: 421 J822
Descriptors: biochemistry and molecular biophysics, ecology, economic entomology, genetics, pathology, pest assessment control and management, population genetics, population studies, toxicology, Diptera, *Chironomus riparius*, malathion, parathion, propoxur, DDT, insecticide resistance, pest control, population genetics, genetics and cytogenetics, environmental biology, toxicology, chemical and physical control, comparative study.

Jaipal, S.; Chaudhary, J.P. (1994) **Laboratory studies on temperature tolerance in *Sturmiopsis inferens tns.* (Tachinidae: Diptera).** *Journal of Insect Science.* 7(1): 93-94. ISSN: 0970-3837.

NAL Call Number: QL461.J68
Descriptors: insect pests of plants, beneficial insects, natural enemies, temperature, hosts, parasitoids, biology, environmental factors, agricultural entomology, *Sturmiopsis inferens*, *Chilo auricilius*, Pyralidae, Lepidoptera, Tachinidae, Diptera, biological control.

Jones, C.J.; Schreiber, E.T. (1994) **Color and height affects oviposition site preferences of *Toxorhynchites splendens* and *Toxorhynchites rutilus rutilus* (Diptera: Culicidae) in the laboratory.** *Environmental Entomology*. 23(1): 130-135. ISSN: 0046-225X.
NAL Call Number: QL461 E532
Descriptors: ecology, economic entomology, nutrition, pest assessment control and management, physiology, reproductive system, Diptera, *Toxorhynchites rutilus rutilus*, *Toxorhynchites splendens*, Florida, biological control, predation, environmental biology, nutrition, biochemistry, comparative study.

Liu, X.; Shun, C.; Hu, Y.; Liu, F.; Wang, Z. (1994) **Laboratory study on the reproductive capacity of *Culex pipiens* pallens at different temperatures.** *Chinese Journal of Parasitic Disease Control.* 7(2): 119-122. ISSN: 1001-6627. Note: In Chinese.
Descriptors: aquatic insects, reproduction, fecundity, environmental factors, temperature, survival, lifespan, gonotrophic cycles, biology, development, *Culex pipiens pallens*, China, aquatic, Diptera, East Asia, developing countries, parasites, vectors, pathogens and biogenic diseases of humans, aquatic biology and ecology, reproduction.

Petitt, F.L.; Wietlisbach, D.O. (1994) **[Laboratory rearing and life history of *Liriomyza sativae* (Diptera: Agromyzidae) on lima bean.]** *Environmental Entomology.* 23(6): 1416-1421. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: insect pests of plants, reproduction, lifespan, fecundity, environmental factors, temperature, relative humidity, rearing techniques, biology, life tables, techniques, grain legumes, agricultural entomology, Diptera, Agromyzidae, *Liriomyza sativae*, *Phaseolus lunatus*, insect behavior, laboratory methods.

Tsuda, Y.; Takagi, M.; Wada, Y. (1994) **Long-term growth patterns of laboratory populations of *Aedes albopictus* (Diptera: Culicidae): A comparison between two strains from Japan and Thailand.** *Japanese Journal of Sanitary Zoology.* 45(2): 133-139. ISSN: 0424-7086.
NAL Call Number: QL99 E3
Descriptors: mosquitoes development, ecology, environmental biology, economic entomology, genetics, physiology, population genetics, population studies, reproductive system, Diptera, *Aedes albopictus*, fecundity, larval food, life history, longevity, population density, population increase, cytogenetics, biochemistry, developmental biology, embryology, morphogenesis, comparative study.

Vaughan, J.A.; Noden, B.H.; Beier, J.C. (1994) **Sporogonic development of cultured *Plasmodium falciparum* in six species of laboratory-reared *Anopheles* mosquitoes.** *American Journal of Tropical Medicine and Hygiene.* 51(2): 233-243. ISSN: 0002-9637.
NAL Call Number: 448.8 AM326
Descriptors: mosquitoes development, ecology, environmental biology, economic

entomology, parasitology, physiology, reproductive system, vector biology, Diptera, Sporozoa, Protozoa, *Anopheles albimanus*, *Anopheles arabiensis*, *Anopheles dirus*, *Anopheles freeborni*, *Anopheles gambiae*, *Anopheles stephensi*, *Plasmodium falciparum*, gene frequency, oocyst, ookinete, population dynamics, vector susceptibility, environmental biology, reproductive system, physiology and biochemistry, developmental biology, embryology, morphogenesis, public health, disease vectors, parasitology, comparative and experimental morphology, physiology, pathology, malaria.

1993

Delpuech, J.M.; Carton, Y.; Roush, R.T. (1993) **Conserving genetic variability of a wild insect population under laboratory conditions.** *Entomologia Experimentalis et Applicata.* 67(3): 233-239. ISSN: 0013-8703.
NAL Call Number: 421 EN895
Descriptors: biochemistry and molecular biophysics, ecology, enzymology, genetics, parasitology, physiology, population genetics, Diptera, chromosomal break, chromosomal dicentric, chromosome aberration, fetal calf serum, genotype, structure, variant, genetics and cytogenetics, population genetics, sex differences, environmental biology, biochemical studies-proteins, peptides and amino acids, enzymes-chemical and physical, parasitology, comparative and experimental morphology, pathology.

Gomes-Hutchings, R.S. (1993) **Development, breeding and behavior of *Toxorhynchites (lynchiella) haemorrhoidalis* (Fabricius, 1794) (Diptera: Culicidae) in the laboratory.** *Acta Amazonica.* 23(1): 37-47. ISSN: 0044-5967. Note: In Portuguese.
NAL Call Number: QH7.A2
Descriptors: laboratory study, predatory behavior, cannibalism, emergence, diet, temperature, feeding, Culicidae, development, ecology, nutrition, physiology, reproductive system, Diptera, *Toxorhynchites haemorrhoidalis haemorrhoidalis*, adult, larva, light conditions, environmental biology, embryology, morphogenesis, comparative and experimental morphology, physiology and pathology.

McMahon, M.J.; R. Gaugler (1993) **Effect of salt marsh drainage on the distribution of *Tabanus nigrovittatus* (Diptera: Tabanidae).** *Journal of medical entomology.* 30(2): 474-476. ISSN: 0022-2585.
NAL Call Number: 421 J828
Abstract: Immature stages of *Tabanus nigrovittatus macquart* inhabit salt marsh sod. A study of the distribution of larvae in relation to the presence or absence of surface water showed that larval densities were higher in salt marsh areas that appeared well drained. Late instars remained above the sod surface more frequently in laboratory conditions mimicking high water-table levels. The development of anaerobic conditions in sod at high water levels probably deterred larvae from burrowing into the sod. Therefore, mosquito control ditches, constructed to augment interstitial drainage inadvertently may have created optimal tabanid larval habitat.
Descriptors: *Tabanus nigrovittatus*, distribution, population density, salt marshes, surface drainage, *Spartina alterniflora*, aquatic environment, New Jersey.

Nunamaker, R.A. (1993) **Rapid cold-hardening in *Culicoides variipennis sonorensis* (Diptera:**

Ceratopogonidae). *Journal of medical entomology.* 30(5): 913-917. ISSN: 0022-2585.
NAL Call Number: 421 J828
Abstract: Rapid cold-hardening was studied in the adult stage of the biting midge *Culicoides variipennis sonorensis* Wirth and Jones from a laboratory colony. No individuals could withstand a direct transfer from 20 degrees C (rearing temperature) to 10 degrees C for 2 h; however, an acclimation period of 1 h at 5 degrees C immediately before exposure to -10 degrees C yielded 96% survival. The cold-hardening response was very rapid; increased cold tolerance peaked after only a 1-h exposure to 5 degrees C. No fly withstood 2 h at 20 degrees C, demonstrating the limitations of the cold-hardening response. Varying degrees of cold tolerance also were induced by a 2-h exposure to 37 degrees C. The ability to rapidly cold-harden varied with the age of the adult insect. Rapid cold-hardening in adult *C. v. sonorensis* may be of ecological and epizootiological significance because it is a mechanism by which a nondiapausing life stage quickly can enhance its tolerance to subzero temperatures.
Descriptors: *Culicoides variipennis*, cold hardening, cold shock, cold tolerance.

Owaga, M.L.; Okelo, R.O.; Chaudhury, M.F. (1993) **Diel activity pattern of the tsetse fly *Glossina austeni newstead* (Diptera: Glossinidae) in the field and in the laboratory.** *Insect Science and its Application.* 14(5-6): 701-705. ISSN: 0191-9040.
NAL Call Number: QL461.I57
Descriptors: biosynchronization, ecology, economic entomology, vector biology, Diptera, *Glossina austeni*, behavioral biology, circadian rhythms and other periodic cycles, environmental biology, materials and apparatus, general field methods.

Ruzickova, J. (1993) **Photoperiodic response of *Chironomus plumosus* (Diptera: Chironomidae) under laboratory conditions.** *Acta Societatis Zoologicae Bohemicae.* 57(1): 53-56. ISSN: 0862-5247.
NAL Call Number: QL1 C4
Descriptors: biosynchronization, development, ecology, freshwater ecology, physiology, Diptera, Osteichthyes, Pisces, *Chironomus plumosus*, carp pond, dormancy, emergency, larvae, circadian rhythms and other periodic cycles, environmental biology, limnology, light and darkness, developmental biology, embryology, morphogenesis, comparative and experimental morphology, pathology.

Sorokin, N.N.; Adamishina, T.A. (1993) **Preservation of seasonal fluctuations of insecticide sensitivity of *Anopheles martinius* after laboratory colonization.** *Meditsinskaya Parazitologiya i Parazitarnye Bolezni.* 0(1): 10-13. ISSN: 0025-8326.
NAL Call Number: 448.8 M469
Descriptors: climatology, economic entomology, genetics, pathology, pest assessment control and management, toxicology, Diptera, *Aedes caspius*, *Anopheles hyrcanus*, *Bacillus thuringiensis var. israelensis*, *Culex pipiens*, malathion, fenitrothion, propoxur, DDT, toxicity, genetics and cytogenetics, ecology, environmental biology, bioclimatology and biometeorology, methods and experimental, comparative and experimental morphology, physiology and pathology.

Stevens, M.M. (1993) **Larval development in *Chironomus tepperi* (Diptera: Chironomidae) under laboratory conditions.** *Environmental Entomology.* 22(4): 776-780. ISSN: 0046-

225X.
NAL Call Number: QL461.E532
Descriptors: aquatic insects, insect reproduction, life cycle, larvae, temperature, environmental factors, biology, development, pests, morphometrics, *Chironomus tepperi*, Diptera, Australia, New South Wales, medical and veterinary entomology records, aquatic biology and ecology.

Thomas, D.B. (1993) **Fecundity and oviposition in laboratory colonies of the screwworm fly (Diptera: Calliphoridae).** *Journal of economic entomology.* 86(5): 1464-1472. ISSN: 0022-0493.
NAL Call Number: 421 J822
Descriptors: mass rearing, egg laying behavior, fecundity, environmental factor, adaptation, laboratory, nuisance, livestock, *Cochliomyia hominivorax*, Calliphoridae, Diptera.

Timmermann, S.E.; Briegel, H. (1993) **Water depth and larval density affect development and accumulation of reserves in laboratory populations of mosquitoes.** *Bulletin of the Society for Vector Ecology.* 18(2): 174-187. ISSN: 0146-6429.
NAL Call Number: RA639 S63
Descriptors: development, ecology, economic entomology, freshwater ecology, metabolism, physiology, public health, allied medical sciences, Diptera, *Aedes aegypti*, *Anopheles albimanus*, *Anopheles gambiae*, *Anopheles stephensi*, eclosion, ecology, food, lipid, protein, vector, environmental biology, limnology, physiology, lipids, proteins, peptides and amino acids, developmental biology, embryology, morphogenesis, public health, disinfection and vector control, pesticides, comparative and experimental morphology, pathology, nutritional status and methods, integumentary system, biochemistry.

Vianna, F.M. (1993) **Interspecific competition between *Peckia chrysostoma* and *Adiscochaeta ingens* (Diptera: Sarcophagidae) larvae reared in laboratory.** *Memorias do Instituto Oswaldo Cruz Rio de Janeiro.* 88(2): 189-194. ISSN: 0074-0276.
NAL Call Number: 448.9 IN74
Descriptors: development, ecology, physiology, Bovidae, Artiodactyla, Canidae, Dicotyledones, Angiospermae, Spermatophyta, Diptera, Monocotyledones, Solanaceae, *Atherigona orientalis*, *Chrysoma megacephala*, *Fannia* sp., *Musca domestica*, *Peckya chrysostoma*, *Phaenicia eximia*, *Synthesiomyia nudiseta*, feces, environmental biology, developmental biology, embryology, morphogenesis, comparative and experimental morphology, pathology.

1992

Aguiar-Valgode, M.; Milward-de'Azevedo, E.M. (1992) **Determination of thermal requirements of *Stomoxys calcitrans* (*l.*) (Diptera, Muscidae), under laboratory conditions.** *Memorias do Instituto Oswaldo Cruz.* 87(Suppl. I): 11-20. ISSN: 0074-0276.
NAL Call Number: 448.9 IN74
Descriptors: temperature, environmental factors, insect life cycle, biology, development,

Diptera, Muscidae, *Stomoxys calcitrans*.

Baba, M. (1992) **Development of immature stages in a blackfly *Simulium kawamurae* (Diptera: Simuliidae) observed in the laboratory.** *Japanese Journal of Sanitary Zoology.* 43(2): 81-88. ISSN: 0424-7086.
NAL Call Number: QL99.E3
Descriptors: aquatic insects, life cycle, temperature, environmental factors, biology, development, *Simulium kawamurae*, Diptera, Japan, East Asia, medical and veterinary entomology records, aquatic insects biology, ecology, reproduction.

Cardoso, D.; Milward-de'Azevedo, E.M. (1992) **Preliminary trials on the influence of relative humidity on the pupal stage of *Cochliomyia hominivorax* (*coq.*) (Diptera: Calliphoridae), under laboratory conditions.** *Arquivos da Universidade Federal Rural do Rio de Janeiro.* 14(1): 101-104. ISSN: 0100-2481.
NAL Call Number: S15 U554
Descriptors: life cycle, relative humidity, environmental factors, biology, development, Diptera, Calliphoridae, *Cochliomyia hominivorax*, parasites, vectors, behavior, insect pests.

Failes, E.S.; Whistlecraft, J.W.; Tomlin, A.D. (1992) **Predatory behavior of *Scatophaga stercoraria* under laboratory conditions.** *Entomophaga.* 37(2): 205-213. ISSN: 0013-8959.
NAL Call Number: 421 En835
Descriptors: age, photoperiod, sex ratio, predatory behavior, entomophagous, laboratory study, predator prey relation, environmental factor, biological control, pest, Diptera.

Ghosh, K.N.; Ghosh, D.K.; De, A.; Bhattacharya, A. (1992) **Biology of *Phlebotomus argentipes annandale* and *brunetti* and *P. papatasi* (*scopoli*) in the laboratory.** *Annales de Parasitologie Humaine et Comparee.* 67(2): 55-61.
NAL Call Number: QL757.P3737
Descriptors: behavior, life cycle, laboratory species, feeding, environmental factors, biology, development, Diptera, Psychodidae, *Phlebotomus papatasi*, *Phlebotomus argentipes*, Cricetinae, Caviidae, parasites, insect vectors, reproduction, laboratory study.

Hogsette, J.A. (1992) **New diets for production of house flies and stable flies (Diptera: Muscidae) in the laboratory.** *Journal of Economic Entomology.* 85(6): 2291-2294. ISSN: 0022-0493.
NAL Call Number: 421 J822
Descriptors: animal husbandry, ecology, economic entomology, nutrition, physiology, Diptera, *Musca domestica*, *Stomoxys calcitrans*, insect pests, laboratory rearing, environmental biology, nutritional status and methods, insect production, sanitary entomology, comparative and experimental morphology, pathology.

Kelly, R.; Edman, J.D. (1992) **Mosquito size and multiple transmission of avian malaria in the laboratory.** *Journal of the American Mosquito Control Association.* 8(4): 386-388. ISSN: 8756-971X.
NAL Call Number: QL536 J686

Descriptors: blood and lymphatics, transport and circulation, dental and oral system, ingestion and assimilation, ecology, morphology, parasitology, physiology, mosquito vector biology, Diptera, *Aedes aegypti*, Protozoa, *Plasmodium gallinaceum*, sporozoa, feeding, malarial sporozoite transmission, salivation, behavioral biology, environmental biology, anatomy and histology, lymphatic and reticuloendothelial pathologies, comparative and experimental morphology, pathology, developmental biology, embryology.

Logan, T.M.; Linthicum, K.J. (1992) **Survival of *Aedes* (*neomelaniconion*) eggs in the laboratory.** *Journal of the American Mosquito Control Association.* 8(1): 89-91. ISSN: 8756-971X.
NAL Call Number: QL536 J686
Descriptors: survival, laboratory study, rearing, mosquito vectors, temperature, environmental factor, *Aedes*, Culicidae, Diptera.

Omar, A.H.; Adham, F.K.; Solimnn, F.S.; Khedre, A. (1992) **Laboratory rearing of *Wohlfahrtia nuba wiedemann* (Diptera: Sarcophagidae) in Egypt.** *Journal of the Egyptian Society of Parasitology.* 22(1): 271-278. ISSN: 1110-0583.
NAL Call Number: QL757.J65
Descriptors: laboratory methods, life cycle, environmental temperature, laboratory rearing, *Wohlfahrtia nuba*, Diptera, Sarcophagidae, Egypt.

Pal, S.C. (1992) *Current Topics in Infectious Disease; Cholera.* Laboratory diagnosis. Natl. Inst. Cholera Enteric Diseases, Beliaghata, Calcutta India, p. 229-251. Plenum Press, London, England, UK. ISBN: 0-306-44077-6.
Descriptors: digestive system, ingestion and assimilation, economic entomology, foods, gastroenterology, human medicine, medical sciences, immune system, chemical coordination and homeostasis, infection, pathology, serology, insect vector biology, Diptera, Vibrionaceae, Eubacteria, flies, *Vibrio cholerae*, environmental samples, immunodiagnosis, serodiagnosis, sewage, specimen collection, specimen transport, stools, water, diagnosis, bacterial immunology and immunochemistry, viral and fungal diseases, medical and clinical microbiology, methods and techniques, bacteriology, serodiagnosis, public health, animate and inanimate disease vectors, sanitary entomology, blood, blood-forming organs and body fluids-blood and lymph studies, public health laboratory methods.

Rajendran, R.; Prasad, P.S. (1992) **Influence of mite infestation on the longevity and fecundity of the mosquito *Mansonia uniformis* (Diptera: Insecta) under laboratory conditions.** *Journal of Biosciences* (Bangalore). 17(1): 35-40. ISSN: 0250-5991.
NAL Call Number: QH1.J63
Descriptors: aging, ecology, parasitology, pathology, physiology, reproductive system, *Mansonia uniformis*, Diptera, parasitism, mites, environmental biology, biochemistry, gerontology, comparative and experimental morphology.

Sassaman, C.; Pratt, G. (1992) ***Melanophora roralis* (*l.*) (Diptera: Rhinophoridae), a parasite of isopod crustaceans, in laboratory culture.** *Entomologist.* 111(4): 178-186. ISSN: 0013-8878.

NAL Call Number: 421 En8
Descriptors: development, ecology, parasitology, physiology, Diptera, Crustacea, *Armadillidium nasatum*, *Armadillidium vulgare*, *Melanophora roralis*, *Oniscus asellus*, *Porcellio dilatatus*, *Porcellio scaber*, *Porcellionides floria*, *Porcellionides pruinosus*, *Trachelipus rathkeyi*, diapause, ecology, host utilization, environmental biology, developmental biology, embryology, morphogenesis, zoology, comparative and experimental morphology, pathology.

Valevich, T.A.; Dergacheva, T.I. (1992) **Laboratory breeding of *Phlebotomus papatasi*. Reaction of the sandfly to unsatisfactory environmental conditions.** *Meditsinskaya Parazitologiya i Parazitarnye Bolezni.* (1): 18-21. ISSN: 0025-8326.
NAL Call Number: 448.8 M469
Descriptors: diapause, biology, development, environmental factors, laboratory rearing techniques, Diptera, Psychodidae, *Phlebotomus papatasi*, methodology, behavior.

Wells, J.D.; Greenberg, B. (1992) **Laboratory interaction between introduced *Chrysomya rufifcies* and native *Cochliomyia macellaria* (Diptera : Calliphoridae).** *Environmental entomology.* 21(3): 640-645. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: interspecific competition, necrophagous, laboratory study, population density, longevity, temperature, environmental factor, *Cochliomyia macellaria*, Calliphoridae, Diptera.

Wilson, M.D.; Post, R.J.; Boakye, D.A. (1992) **Studies on environmentally-induced color variation in *Simulium-sirbanum* (Diptera, Simuliidae) using a portable rearing system.** *Annals of Tropical Medicine and Parasitology.* 86(2): 169-174. ISSN: 0003-4983.
NAL Call Number: 448.9 L75A
Abstract: Previous studies on the morphological identification of adult female *Simulium damnosum s.l.* have involved use of colour characters. To determine the degree to which these qualitative characters are influenced by the physical environment, a portable rearing system was constructed. Wild-caught female flies and flies emerging from pupae maintained at ambient temperatures or above showed entirely pale antennae, fore-coxae, wing-tufts and hairs on the scutellum and ninth abdominal tergite, as is normal for *S. sirbanum*. Adults reared from larvae at below ambient temperatures were also pale, except for the antennae which were dark in all specimens. Adult females emerging from pupae maintained at below ambient temperatures were entirely pale up to the fourth day of emergence and mostly with dark antennae. The biological significance and the implications to the morphological identification of the savannah species of the *S. damnosum* complex in West Africa are discussed.
Descriptors: Onchocerciasis control program, complex, insect vectors, anatomy and histology, Simuliidae, growth and development, pigmentation, temperature, Diptera, Africa, area.

Yee Wee, L.; Foster, W.A. (1992) **Diel sugar-feeding and host-seeking rhythms in mosquitoes (Diptera: Culicidae) under laboratory conditions.** *Journal of Medical Entomology.* 29(5): 784-791. ISSN: 0022-2585.

NAL Call Number: 421 J828
Descriptors: behavior, biochemistry and molecular biophysics, biosynchronization, ecology, economic entomology, nutrition, physiology, sense organs, sensory reception, Diptera, *Aedes aegypti*, *Aedes triseriatus*, *Anopheles quadrimaculatus*, *Culex quinquefasciatus*, scotophase, behavioral biology, circadian rhythms and other periodic cycles, environmental biology, nutritional status and methods, sense organs, associated structures and functions, comparative and experimental morphology, pathology, external effects-light and darkness, reproductive system.

1991

Chamberlain, W.F.; Scholl, P.J. (1991) **New procedures to enhance survival of 3rd-instar *Hypoderma lineatum* (*villers*) (Diptera, Oestridae) in artificial media.** *Journal of Medical Entomology.* 28(2): 266-269.
NAL Call Number: 421 J828
Descriptors: *Hypoderma lineatum*, laboratory rearing technique, antibiotics, culture media.

Hing, C.T. (1991) **Demographic parameters of *Bactrocera* sp. (*malaysian b*) (Diptera: Tephritidae) in the laboratory.** *Journal of Plant Protection in the Tropics.* 8(3): 139-144. ISSN: 0127-6883.
NAL Call Number: SB950.3 M3J68
Descriptors: ecology, economic entomology, horticulture, methods and techniques, physiology, Spermatophyta, Diptera, Myrtaceae, Anacardiaceae, *Bactrocera dorsalis*, *Bactrocera latifrons*, *Bactrocera* sp, hatchability, environmental biology, comparative and experimental morphology, pathology, reproductive system.

Stein, W. (1991) **To the occurrence of *Ophyra aenescens* (*wiedemann*) (Dipt., Muscidae) in Germany. V: laboratory analyses for the behavior of the imagines.** *Zeitschrift fuer Angewandte Zoologie.* 78(2): 219-233. ISSN: 0044-2291.
NAL Call Number: 449.8 Z36
Descriptors: breeding behavior, sexual behavior, locomotion, flight, laboratory study, terrestrial environment, Muscidae, Diptera.

1990

Hemeida, I.A.; Kelany, I.M.; Ali, W.M. (1990) **Notes on the biology of bean fly, *Melanagromyza phaseoli tryon*, under laboratory conditions.** *Zagazig Journal of Agricultural Research.* 17(4B): 1293-1298. ISSN: 1110-0338. Notes: 2 tables; 8 ref.
NAL Call Number: S3 Z34
Descriptors: *Melanagromyza*, life cycle, environmental factors, seasonal development, laboratory experimentation, Agromyzidae, biological development, Diptera.

Koveos, D.S.; Tzanakakis, M.E. (1990) **Effect of the presence of olive fruit on ovarian maturation in the olive fruit fly, *Dacus oleae*, under laboratory conditions.** *Entomologia Experimentalis et Applicata.* 55(2): 161-168. ISSN: 0013-8703.

NAL Call Number: 421 En895
Descriptors: ripening, ovary, fruit, diapause, photoperiod, temperature, laboratory study, insect plant relationships, pest, fruit tree, environmental factors, *Dacus oleae*, *Olea europaea*, Tephritidae, Diptera, Spermatophyta.

Linde, T.C. van der; Hewitt, P.H.; Nel, A.; Westhuizen, M.C. van der. (1990) **The influence of different constant temperatures and saturation deficits on the survival of adult *Culex* (*culex*) *theileri theobald* (Diptera: Culicidae) in the laboratory.** *Journal of the Entomological Society of Southern Africa.* 53(1): 57-63. ISSN: 0013-8789.
NAL Call Number: 420 En86
Descriptors: temperature, adults, environmental factors, survival, lifespan, biology, development, Diptera, Culicidae, *Culex theileri*, adult mosquitoes.

Randolph, S.E.; Rogers, D.J.; Kiilu, J. (1990) **Rapid changes in the reproductive cycle of wild-caught tsetse, *Glossina pallidipes austen*, when brought into the laboratory.** *Insect Science and its Application.* 11(3): 347-354. ISSN: 0191-9040.
NAL Call Number: QL461.I57
Descriptors: insect reproduction, physiology, ovarioles, environmental factors, laboratory rearing, life cycle, biology, development, Diptera, *Glossina pallidipes*, Kenya, insect behavior.

Schlein, Y.; Borut, S.; Jacobson, R.L. (1990) **Oviposition diapause and other factors affecting the egg-laying of *Phlebotomus papatasi* in the laboratory.** *Medical and Veterinary Entomology.* 4(1): 69-78.
NAL Call Number: RA639.M44
Descriptors: *Phlebotomus papatasi*, diapause, ultraviolet radiation, environmental factors, oviposition, laboratory rearing techniques, developmental stages, Diptera, dormancy, physiological functions, Psychodidae, radiations, sexual reproduction.

1989

Chadee, D.D.; Corbet, P.S. (1989) **Diel pattern of oviposition in the laboratory of the mosquito *Aedes albopictus* (*skuse*) (Diptera: Culicidae).** *Annals of Tropical Medicine and Parasitology.* 83(4): 423-429. ISSN: 0003-4983.
NAL Call Number: 448.9 L75A
Descriptors: photoperiod, environmental factors, biological rhythms, behavior, oviposition, Diptera, Culicidae, *Aedes albopictus*, mosquitoes.

Collier, R.H.; Finch, S.; Anderson, M. (1989) **Laboratory studies on late-emergence in the cabbage root fly (*Delia radicum*).** *Entomologia Experimentalis et Applicata.* 50(3): 233-240. ISSN: 0013-8703.
NAL Call Number: 421 EN895
Descriptors: environmental factors, heat sums, temperature, pests, forecasting, biology, diapause, agricultural entomology, Anthomyiidae, Diptera, *Delia radicum*, UK, pathogens of plants, laboratory study.

Doku, C.; Brady, J. (1989) **Landing site preferences of *Glossina morsitans morsitans***

***westwood* (Diptera: Glossinidae) in the laboratory: avoidance of horizontal features?** *Bulletin of Entomological Research.* 79(3): 521-528. ISSN: 0007-4853.
NAL Call Number: 421 B87
Descriptors: *Glossina morsitans morsitans*, orientation, landing site preferences, spatial environment, horizontal features effect on landing site choice, behavior, abiotic factors, physical factors, Diptera, true flies.

Ghosh, K.N.; Ghosh, D.K.; Bhattacharya, A. (1989) **Temperature difference, an useful stimulus for feeding phlebotomine sandflies (Diptera : Psychodidae) in the laboratory.** *Rivista di Parassitologia.* 50(3): 317-320. ISSN: 0035-6387.
NAL Call Number: 436.8 R52
Descriptors: laboratory feeding, environmental factors, temperature, insect vector, *Phlebotomus argentipes*, *Phlebotomus papatasi*, blood sucking, Diptera, leishmaniasis, protozoal disease, infection.

Grafenstein, J. von; Ulber, B. (1989) **Laboratory studies on the influences of soil structure, soil humidity and microclimate on oviposition in the wheat bulb fly (*Delia coarctata*) (Fall.) (Dipt., Anthomyiidae).** *Mitteilungen der Deutschen Gesellschaft fur Allgemeine und Angewandte Entomologie.* 7(1-2): 199-204. ISSN: 0344-9084. Note: In German.
NAL Call Number: QL461 M68
Descriptors: environmental factors, biology, behavior, oviposition, soil, cereals, agricultural entomology, *Delia coarctata*, Diptera, insect pests of plants.

Hanazato, T.; Yasuno, M. (1989) **Effect of temperature in laboratory studies on growth of *Chaoborus flavicans* (Diptera: Chaoboridae).** *Archiv fur Hydrobiologie.* 114(4): 497-504.
NAL Call Number: 410 Ar28 Suppl.
Descriptors: development, biology, environmental factors, *Chaoborus flavicans*, Diptera, East Asia, medical and veterinary entomology records.

Hulme, M.A. (1989) **Laboratory assessment of predation by *Lonchaea corticis* (Diptera: Lonchaeidae) on *Pissodes strobi* (Coleoptera: Curculionidae).** *Environmental entomology.* 18(6): 1011-1014. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: predator-prey relationship and efficiency, temperature effects, insect pest, softwood forest tree, environmental factor, interspecific relation, Lonchaeidae, *Pissodes strobi*, Diptera, Coleoptera.

Hunt, G.J.; Tabachnick, W.J.; McKinnon, C.N. (1989) **Environmental factors affecting mortality of adult *Culicoides variipennis* (Diptera: Ceratopogonidae) in the laboratory.** *Journal of the American Mosquito Control Association.* 5(3): 387-91. ISSN: 8756-971X.
NAL Call Number: QL536.J686
ABSTRACT: The effects of several environmental factors on mortality of adult *Culicoides variipennis* in the laboratory were evaluated. Daily mortality rates significantly increased when adult midges were maintained at an elevated constant temperature (26 degrees C). Adult *C. variipennis* handled the least during routine

maintenance procedures had the lowest daily mortality rate. Survival was not significantly affected by varying density levels of adult midges in the size of container routinely used in our laboratory. Implications of these observations using adult *C. variipennis* for future studies are discussed.
Descriptors: *Culicoides variipennis*, growth and development, insect vectors, analysis of variance, blood, physiology, eating, insect vectors, oviposition, random allocation, temperature, laboratory study, adult midges.

Ruuth, P.; Stenman, K. (1989) **Laboratory rearing of the turnip root fly, *Delia floralis* (Diptera, Anthomyiidae).** *Entomologisk Tidskrift.* 110(4): 145-148. ISSN: 0013-886X.
NAL Call Number: 421 EN891
Descriptors: laboratory rearing, Sweden, temperature, environmental factors, egg laying, diapause, development, Diptera.

1988

Baba, M.; Takaoka, H.; Ochoa, J.O.; Juarez, E.L.; Tada, I.; Shimada, M. (1988) **Laboratory observations on oviposition and egg development of Guatemalan *Simulium ochraceum* (Diptera: Simuliidae) at different temperatures.** *Eisei Dobutsu (Medical Entomology and Zoology).* 39(4): 363-367. ISSN: 0424-7086. Note: Journal Number: Z0441BAP.
NAL Call Number: QL99.E3
Descriptors: Simuliidae, egg-laying, growth, temperature dependence, varying temperature conditions, indoor environment, habitat environment, reproductive behavior, Guatemala, Diptera, Pterygota, dependence, conditions, environment in building.

Benzon, G.L.; Apperson, C.S.; Clay, W. (1988) **Factors affecting oviposition site preference by *Toxorhynchites splendens* in the laboratory.** *Journal of the American Mosquito Control Association.* 4(1): 20-22. ISSN: 8756-971X.
NAL Call Number: QL536 J686
Descriptors: egg laying, humidity, luminous stimulus, Culicidae, vision, site, laboratory study, vector, environmental factor, Diptera.

Brady, J.; Shereni, W. (1988) **Landing responses of the tsetse fly *Glossina morsitans morsitans westwood* and the stable fly *Stomoxys calcitrans* (*l.*) (Diptera: Glossinidae and Muscidae) to black-and-white patterns: a laboratory study.** *Bulletin of Entomological Research.* 78(2): 301-311.
NAL Call Number: 421 B87
Descriptors: Glossinidae, Muscidae, colour, behavior, orientation, experiments, chemicophysical properties, Diptera, environment, optical properties, research, site factors, landing behavior of flies.

Dadd, R.H.; Kleinjan, J.E.; Asman, S.M. (1988) **Eicosapentaenoic acid in mosquito tissues: differences between wild and laboratory-reared adults.** *Environmental entomology.* 17(2): 172-180. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: nutrient requirement, fatty acid compounds, chemical composition,

intraspecific comparison, diet, thin layer, chromatography, comparative study, from freshwater environment, laboratory feeding, *Culex tarsalis*, Diptera.

Lanzaro, G.C.; Narang, S.K.; Mitchell, S.E.; Kaiser, P.E.; Seawright, J.A. (1988) **Hybrid male sterility in crosses between field and laboratory strains of *Anopheles quadrimaculatus* (*say*) (Diptera: Culicidae).** *Journal of Medical Entomology.* 25(4): 248-255. ISSN: 0022-2585.
NAL Call Number: 421 J828
Descriptors: reproductive isolation, speciation, hybridization, species complex, male sterility, intraspecific comparison, survival, United States, development, reproduction, genital system, laboratory study, insect vector, freshwater environment, *Anopheles quadrimaculatus*, North America, Culicidae, Diptera.

Martinez, S.G. (1988) *El efecto de los diversos tipos y humedad del suelo nivela en los ludens de Anastrepha del adulto (Diptera: Tephritidae) bajo condiciones del invernadero y del laboratorio. [Effect of different soil types and moisture levels on adult Anastrepha ludens (Diptera: Tephritidae) under glasshouse and laboratory conditions].* Chapingo, Mex. (Mexico), 94 p. Thesis Degree: Tesis (Ing. Agr. Esp. en Parasitologia Agricola).
Note: In Spanish.
Descriptors: *Anastrepha*, irrigated soils, moisture content, experiments, greenhouse crops, laboratories, composition, cultural soil types, Diptera, economic sectors, environment, fruit damaging insects, fruit flies, horticulture, injurious factors, noxious insects, pests, primary sector, research, site factors, soil types.

Meyer, J.A.; Mullens, B.A. (1988) **Development of immature *Fannia* spp. (Diptera: Muscidae) at constant laboratory temperatures.** *Journal of Medical Entomology.* 25(3): 165-171. ISSN: 0022-2585.
NAL Call Number: 421 J828
Descriptors: development, temperature, biology, environmental factors, Diptera, *Fannia canicularis*, *Fannia femoralis*, California, behavior in laboratory rearing.

Ray, S.; Choudhury, A. (1988) **Salinity tolerance of *Culex sitiens wied.* (Diptera: Culicidae) larvae in laboratory conditions.** *Current Science.* 57(3): 159-160. ISSN: 0011-3891.
NAL Call Number: 475 Sci23
Descriptors: mosquito breeding places, salinity, environmental factors, estuaries, ecology, salt tolerance, mosquito nets, *Culex sitiens*, Diptera, India, control measures, behavior.

Suenaga, O. (1988) **Prevention of contamination among mosquito strains caused by the aeration for larval rearing in the laboratory.** *Tropical Medicine.* 30(1): 39-43. ISSN: 0385-5643.
Descriptors: *Culex pipiens pallens*, larva, breeding, rearing, pollution, dirt, prevention of pollution, aeration, laboratory rearing, Diptera, Pterygota, growth stage, management, environmental pollution control, countermeasure, preclusion, strain protection, room.

Zhou, C. (1988) **Studies on the population ecology of *Aedes albopictus* III. The effect of temperature on laboratory population and life tables of *Aedes albopictus*.** *Ecologic*

Science. (1): 46-50. Notes: 1 ill., 4 tables, 8 ref, In Chinese.
Descriptors: *Aedes*, population ecology, environmental conditions, forecasting, developmental stages, temperature, laboratory experiments, Culicidae, developmental stages.

1987

Beier, M.S.; Beier, J.C.; Merdan, A.A.; El-Sawaf, B.M.; Kadder, M.A. (1987) **Laboratory rearing techniques and adult life table parameters for *Anopheles sergentii* from Egypt.** *Journal of the American Mosquito Control Association.* 3(2): 266-270. ISSN: 8756-971X.
NAL Call Number: QL536 J686
Descriptors: biology, development, environmental factors, survival, insect behavior, population ecology, rearing techniques, ecology, life tables, vectorial capacity, disease vectors, mosquito nets, Culicidae, Diptera, *Anopheles sergentii*, *Plasmodium falciparum*, *Plasmodium vivax*, Egypt, control measures.

Benschoter, C.A. (1987) **Effects of modified atmospheres and refrigeration temperatures on survival of eggs and larvae of the Caribbean fruit fly (Diptera: Tephritidae) in laboratory diet.** *Journal of Economic Entomology.* 80(6): 1223-1225. ISSN: 0022-0493.
NAL Call Number: 421 J822
Descriptors: oxygen, carbon dioxide, stored fruit products, insect pests, biology, environmental factors, cold resistance, controlled atmospheres, stored products, biodeterioration, pest control, agricultural entomology, CAS Registry Numbers: 7782-44-7; 124-38-9, *Anastrepha suspense*, Diptera, storage problems, pests of food, environmental control in structures, pathogen, management.

Chamberlain, W.F. (1987) **Responses of wild and laboratory-reared horn flies (Diptera: Muscidae) to heat, light, and airflow.** *Environmental Entomology.* 60(5): 1107-1113. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: smell, attractants, odors, activity, flight, behavior, environmental factors, insect attractants, host searching behavior, *Haematobia irritans*, Diptera, Muscidae, medical and veterinary entomology.

Fay, H.A.; Meats, A. (1987) **Survival rates of the Queensland fruit fly, *Dacus tryoni*, in early spring: field-cage studies with cold-acclimated wild flies and irradiated, warm- or cold-acclimated, laboratory flies.** *Australian Journal of Zoology.* 35(2): 187-195. ISSN: 0004-959X.
NAL Call Number: 410 Au73
Descriptors: temperature, gamma radiation, insect pests of fruits, sterile insect release, biology, environmental factors, insect genetics, pest control, agricultural entomology, *Dacus tryoni*, Diptera, Tephritidae, *Bactrocera tryoni*, New South Wales, Australia, pest management, control measures.

Gonzalez, B.R.; Alonso, N.N.; Navarro, O.A. (1987) **Resultados obtenidos en el laboratorio en la crianza del wiedemann del albimanus de los anopheles, 1821 (Diptera-Culicidae)**

en Cuba. [Results obtained in the laboratory on the breeding of *Anopheles albimanus wiedemann*, *1821* (Diptera-Culicidae) in Cuba.] *Revista Cubana de Medicina Tropical.* 39(1): 133-8. ISSN: 0375-0760. Note: In Spanish.
Descriptors: *Anopheles* physiology, environment, oviposition, reproduction, sex characteristics, mosquitoes.

Killick-Kendrick, R.; Killick-Kendrick, M. (1987) **The laboratory colonization of *Phlebotomus ariasi* (Diptera: Psychodidae).** *Annales de Parasitologie Humaine et Comparee.* 62(4): 354-356.
NAL Call Number: QL757.P3737
Descriptors: diapause, reproduction, environmental factors, laboratory rearing techniques, *Phlebotomus ariasi*, Psychodidae, Diptera, France, methodology, behavior.

Meats, A.; Fitt, G.P. (1987) **Survival of repeated frosts by the Queensland fruit fly, *Dacus tryoni*: experiments in laboratory simulated climates with either step or ramp fluctuations of temperature.** *Entomologia experimentalis et applicata.* 45(1): 9-16. ISSN: 0013-8703.
NAL Call Number: 421 En895
Descriptors: cold, mortality, sensitivity resistance, overwintering, environmental factor, thermoregulation, *Dacus tryoni*, Tephritidae, Diptera.

Morris, D.E.; Cloutier, C. (1987) **Biology of the predatory fly *Coenosia tigrina* (*fab.*) (Diptera: Anthomyiidae): reproduction, development and larval feeding on earthworms in the laboratory.** *Canadian entomologist.* 119(4): 381-393. ISSN: 0008-347X.
NAL Call Number: 421 C16
Descriptors: Diptera, development, larval feeding, predatory behavior, temperature, reproduction, Oligochaeta, feeding behavior, entomophagous, environmental factor, Anthomyiidae, *Eisenia fetida*, Annelida.

Peterson, R.D., II; Candido, A.O. (1987) **Larval and pupal weight relationships of six strains of screwworm (Diptera: Calliphoridae) reared in the laboratory and in wounds.** *Journal of Economic Entomology.* 80(6): 1213-1217. ISSN: 0022-0493.
NAL Call Number: 421 J822
Descriptors: environmental factors, diets, myiasis, biology, development, laboratory rearing, rearing techniques, Diptera, Calliphoridae, *Cochliomyia hominivorax*, sheep, parasites, insect vectors, pathogens and biogenic diseases, techniques and methodology, behavior.

Schroeder, P. (1987) **Size selection of latex beads by blackfly larvae (Diptera: Simuliidae) in the laboratory.** *Hydrobiologia.* 144(2): 163-171. ISSN: 0018-8158.
NAL Call Number: 410 H992
Descriptors: prey selection, feeding behavior, larva, filter feeder species, experimental study, freshwater environment, *Simulium ornatum*, Germany, Diptera.

Vaughan, J.A.; Turner, E.C., Jr. (1987) **Development of immature *Culicoides variipennis* (Diptera: Ceratopogonidae) from Saltville, Virginia, at constant laboratory**

temperatures. *Journal of Medical Entomology.* 24(3): 390-395. ISSN: 0022-2585.
NAL Call Number: 421 J828
Descriptors: environmental factors, biology, development, *Culicoides variipennis*, Ceratopogonidae, Diptera, Virginia, laboratory rearing.

Williams, D.D. (1987) **A laboratory study of predatorprey interactions of stoneflies and mayflies.** *Freshwater biology.* 17(3): 471-490. ISSN: 0046-5070.
NAL Call Number: QH96.F6
Descriptors: Plecoptera, Ephemeroptera, predator prey relation, predatory behavior, detection, habitat, experimental study, antenna, freshwater environment, stream insects, Ontario.

1986

McDaniel, I.N. (1986) **Swarming and mating of univoltine *Aedes mosquitoes* in the laboratory.** *Journal of the American Mosquito Control Association.* 2(3): 321-324. ISSN: 8756-971X.
NAL Call Number: QL536 J686
Descriptors: Diptera, humidity, temperature, light, nuptial flight, mating, Maine, vector, ecology, environmental factors, Culicidae, *Aedes communis*, laboratory study.

Moore, M.V. (1986) **Method for culturing the phantom midge, *Chaoborus* (Diptera: Chaoboridae), in the laboratory.** *Aquaculture.* 56(3-4): 307-316. ISSN: 0044-8486.
NAL Call Number: SH1 A6
Descriptors: Diptera, rearing, laboratory study, freshwater environment, aquaculture, United States, *Chaoborus punctipennis*.

Ouda, N.A.; Al-Chalabi, B. (1986) **Laboratory study on the suitability of various sources of field water as breeding places for *Culex quinquefasciatus say* (Diptera, Culicidae).** *Journal of biological sciences research* (Baghdad). 17(1): 199-209. ISSN: 528307.
NAL Call Number: QH301 J66
Descriptors: Diptera, life history, salinity, Iraq, water, mosquito vector, Culicidae, environmental factor, freshwater environment, *Culex pipiens quinquefasciatus*, Asia.

1985

Carruthers, R.I.; Haynes, D.L. (1985) **Laboratory transmission and in vivo incubation of *Entomophthora muscae* (Entomophthorales: Entomophthoracae) in the onion fly, *Delia antique* (Diptera: Anthomyridae).** *Journal of invertebrate pathology.* 45(3): 282-287. ISSN: 0022-2011.
NAL Call Number: 421 J826
Descriptors: Diptera, vegetable crop, fungi, entomopathogen, epidemiology, infectivity, temperature, pest, Anthomyiidae, environmental factor, *Delia antique*, *Allium cepa*.

Finch, S.; Collier, R.H. (1985) **Laboratory studies on aestivation in the cabbage root fly (*Delia radicum*).** *Entomologia experimentalis et applicata.* 38(2): 137-143. ISSN: 0013-

8703.
NAL Call Number: 421 En895
Descriptors: Diptera, development, diapause, estivation, temperature, laboratory study, insect pest of plants, Anthomyiidae, environmental factor.

Kuramochi, K. (1985) **Studies on the reproductive biology of the horn fly, *Haematobia irritans* (*l.*) (Diptera: Muscidae). II: Effect of temperature on follicle development and blood meal volume of laboratory-reared flies.** *Applied Entomology and Zoology.* 20(3): 264-270. ISSN: 0003-6862.
NAL Call Number: SB599.A6
Descriptors: Diptera, development, ovarian follicle, food intake, temperature, parasite, cattle, blood sucking fly, environmental factor, Muscidae.

Ouda, N.A.; Mehdi, N.S.; Dikran, B.B. (1985) **Field and laboratory observations on the biology of *Culex-Culex quinquefasciatus say* and *Culex pipiens molestus forskal.*** *Journal of Biological Sciences Research.* 16(2): 231-238.
NAL Call Number: QH301.J66
Descriptors: mosquito ecology, environmental factors, mosquito nets, water tanks, Diptera, Culicidae, *Culex pipiens*, *Culex quinquefasciatus*, Iraq, West Asia, Middle East, medical and veterinary entomology, control measures, behavior.

Zakharova, N.F.; Rasnitsyn, S.P. (1985) **Sexual activity of *Anopheles sacharovi favre* in a laboratory environment.** *Meditsinskaia parazitologiia i parazitarnye bolezni.* (4): 58-64. ISSN: 0025-8326. Note: In Russian.
NAL Call Number: 448.8 M469
Descriptors: *Anopheles* physiology, sex behavior, aging, copulation physiology, mosquito.

1984

Gao, J.Z.; Zhen, Z.Y.; Xue, J.M.; Huang, P.Y.; Zhao, J.P.; Cao, N.H. (1984) **Studies on the longevity of adult *Aedes* (*s.*) *alpopictus* (*skuse*): the longevity of caged females under laboratory conditions.** *Acta entomologica sinica.* 27(2): 182-188. ISSN: 0163-6839.
NAL Call Number: QL461.A22
Descriptors: China, Diptera, survival, mosquito longevity, temperature, relative humidity, laboratory study, environmental factor, Culicidae.

Ham, P.J.; Gale, C.L. (1984) **Blood meal enhanced *Onchocerca* development and its correlation with fecundity in laboratory reared blackflies (Diptera, Simuliidae).** *Tropenmedizin und Parasitologie.* 35(4): 212-6. ISSN: 0303-4208.
NAL Call Number: 448.8 Z37
Descriptors: blood, *Onchocerca* growth and development, Simuliidae physiology, fertility, insect vectors, Simuliidae, parasitology.

1983

Mullens, B.A.; Rutz, D.A. (1983) **Development of immature *Culicoides variipennis* (Diptera: Ceratopogonidae) at constant laboratory temperatures.** *Annals of the Entomological Society of America.* 76(4): 747-751. ISSN: 0013-8746.
NAL Call Number: 420 En82
Descriptors: Diptera, laboratory rearing, temperature, development, duration, degree day, body size, Ceratopogonidae, *Culicoides variipennis*, blood sucking, environmental factor.

Pappas, L.G.; Pappas, C.D. (1983) **Laboratory studies on the significance of NaCl as an oviposition deterrent in *Culiseta inornata*.** *Mosquito News.* 43(2): 153-155. ISSN: 0027-142X.
NAL Call Number: 421 M85
Descriptors: Diptera, mosquito egg laying, hatching, salinity effects, environment, vector, *Culiseta inornata*, environmental factor.

Simmons, K.R.; Raybould, J.N.; Meredith, S.E.; Garms, R. (1983) **Identification of a laboratory mating form of the *Simulium damnosum theobald* complex in West Africa.** *Annals of tropical medicine and parasitology.* 77(5): 523-526. ISSN: 0003-4983.
NAL Call Number: 448.9 L75A
Descriptors: Diptera, mosquito vector, identification, nymph, larva, mating, blood meal, egg laying, West Africa, freshwater environment, biology, reproduction, *Simulium damnosum*.

1982

Adham, F.K. (1982) **Establishment of a colony of the mosquito *Culiseta longiareolata* under laboratory conditions.** *Experientia.* 38(12): 1498-1499. ISSN: 0014-4754.
NAL Call Number: 475 Ex7
Descriptors: Diptera, mosquito colony, laboratory study, temperature, photoperiod, *Culiseta longiareolata*, environmental factor.

Band, H.T.; Band, R.N. (1982) **Multiple overwintering mechanisms in *Chymomyza amoena* larvae (Diptera: Drosophilidae) and laboratory induction of freeze tolerance.** *Experientia.* 38 (12): 1448-1449. ISSN: 0014-4754.
NAL Call Number: 475 Ex7
Descriptors: *Chymomyza amoena*, Diptera, fly hibernation, tolerance, cold, cryoprotective agent, Drosophilidae, environmental factor.

Kitaoka, S. (1982) **Effects of rearing temperature on length of larval period and size of adults in *Culicoides arakawae* and *Culicoides maculatus* (Diptera: Ceratopogonidae).** *National Institute of Animal Health Quarterly.* 22(4): 159-162. ISSN: 0027-951X.
NAL Call Number: 41.9 T575Q
Descriptors: chickens, Ceratopogonidae, leucocytozoon, insect vectors, environmental temperature, larvae, insect developmental stages, coccidian, developmental stages, Diptera, disease transmission, environment, environmental conditions, epidemiology,

Galliformes, poultry, protozoa, sporozoa, temperature.

Rowcliffe, C.; Finlayson, L.H. (1982) **Active and resting behavior of virgin and pregnant females of *Glossina morsitans morsitans westwood* (Diptera: Glossinidae) in the laboratory.** *Bulletin of Entomological Research.* 72(2): 271-288. ISSN: 0007-4853.
NAL Call Number: 421 B87
Descriptors: *Glossina morsitans morsitans*, reproductive condition, active and resting behavior, environment effects, diel activity pattern, virgin and pregnant females, habitat preference, abiotic factors, circadian activity, ecology, habitat utilization, abiotic factors, Cyclorrhapha, Brachycera, Diptera, true flies.

Zervas, G. (1982) **Αναπαραγωγική φυσιολογία dacus των tephritidae δίπτερων oleae (Gmelin).** Η σύγκριση των άγρια περιοχών και του εργαστηρίου εξέθρεψε τις μύγες. **[Reproductive physiology of *Dacus oleae* (Gmelin) Diptera Tephritidae. Comparison of wild and laboratory reared flies.]** *Geoponika.* (282): 10-14. ISSN: 0016-9625. Notes: 5 fig., 17 ref., In Greek.
NAL Call Number: S16 G9G4
Abstract: The mating activity of the olive fruit fly, *Dacus oleae*, is a rhythmical phenomenon, controlled by a circadian rhythm, occurring at the end of the photophase. Under continuous white light works as a free running rhythm for several days, with a periodicity of less than 24 hrs. The sexual activity, in both sexes, is controlled and synchronized by the same rhythm. The synchronization and the steady-state of the rhythm is defined by the length of the scotophase, which in fact controls the manifestation of the rhythm. Light intensity up to 45.000 lux able to mate daily for up to 40 consecutive days. Therefore about 12 hrs within the same period. The previous mating activity of males did not affect their sexual rhythm and activity, since they were able to mate daily for up to 40 consecutive days. Therefore they are characterized as polygamous. Non-irradiated males conveyed sperm to all their mating partners, most laboratory reared females, the sterilized ones were mating. Wild males mated less frequently than laboratory reared males, sterilized or not. Females, after each successful mating become sexually unreceptive for a period of several days. In fact, most females, wild or laboratory reared, sterilized or not mated twice, considerably fewer mated once and even fewer three times, thus characterized as oligogamous. Among laboratory reared females, the sterilized ones were mated more frequently than the non-sterilized, while wild females were mated less than both categories of the laboratory-reared.
Descriptors: *Dacus oleae*, males, females, Diptera, sexual behavior, sexual reproduction, laboratory experimentation, photoperiodicity, darkness, Greece, environmental factors, experimentation, light regimes, physiological functions, Tephritidae.

1981

Beerwinkle, K.R.; March, P.A. (1981) **A cam-operated, electronic proportional-control system for laboratory simulation of outside summer temperatures.** *Southwestern Entomologist* 6(1): 53-56. ISSN: 0147-1724.
NAL Call Number: QL461.S65
Descriptors: comprehensive zoology, environmental control device, temperature, simulation control system, *Haematobia irritans*, Muscidae, dung habitat, temperature

effect on larval migration, laboratory simulation, techniques, care in captivity, housing techniques, terrestrial habitat, abiotic factors, physical factors, Cyclorrhapha, Brachycera, Diptera, true flies.

Haq, N.; Reisen, W.K.; Muhammad, A. (1981) **The effects of *Nosema algerae* on the horizontal life table attributes of *Anopheles stephensi* under laboratory conditions.** *Journal of invertebrate pathology.* 37(3): 236-242. ISSN: 0022-2011.
NAL Call Number: 421 J826
Descriptors: entomopathogen, life cycle, India, vector, laboratory study, tropical environment, *Anopheles stephensi*, Cnidosporidia, Culicidae, life history, Diptera, Microsporidia, *Nosema algerae*, pathogenicity, Protozoal disease.

Stein, W. (1981) **Laboratoriumsuntersuchungen zum verhalten von Lucilia sericata (Meig.) (Dipt., Calliphoridae) gegenuber abiotischen Faktoren. [Laboratory analyses to the behavior of *Lucilia sericata* (*meig.*) (Dipt., Calliphoridae) more gegenuber abiotischen factors.]** *Zeitschrift Fuer Angewandte Entomologie.* 92(4): 384-398. Note: In German with English summary.
Descriptors: *Lucilia sericata*, Calliphoridae, starvation, modification of orientation reactions to environmental factors, relative humidity and starvation relationships, light, temperature, orientation relationships, nutrition, behavior, abiotic factors, physical factors, Cyclorrhapha, Brachycera, Diptera, true flies.

1980

Begemann, G.J. (1980) **Laboratory studies on the biology of *Simulium nigritarse coquillett* and *Simulium adersi pomeroy* (Diptera: Simuliidae).** *Onderstepoort Journal of Veterinary Research.* 47(4): 203-211. ISSN: 0030-2465.
NAL Call Number: 41.8 On1
Descriptors: *Simulium adersi*, egg, incubation period, larva, stages duration and position of attachment in aquatic environment, pupa, temperature effects, metamorphosis, pupation, water depth, light intensity and water current speed effects, emergence from pupa, eclosion rhythms, *Simulium nigritarse*, dormancy, physiology, reproduction, life cycle and development, Nematocera, Diptera, true flies.

Smyly, W.J. (1980) **Food and feeding of aquatic larvae of the midge *Chaoborus flavicans* (*meigen*) (Diptera: Chaoboridae) in the laboratory.** *Hydrobiologia.* 70(1-2): 179-188. ISSN: 0018-8158.
NAL Call Number: 410 H992
Descriptors: *Chaoborus flavicans*, feeding behavior, Diptera, laboratory, rearing midge larva, freshwater environment, diet, ethology.

Winner, R.W.; Greber, J.S. (1980) **Prey selection by *Chaoborus punctipennis* under laboratory conditions.** *Hydrobiologia.* 68(3): 231-233. ISSN: 0018-8158.
NAL Call Number: 410 H992
Descriptors: *Chaoborus punctipennis*, prey selection, behavior, Crustacea, Culicidae, Diptera, larva, freshwater environment, predation, ethology.

1979

Greany, P.D.; Szentesi, A. (1979) **Oviposition behavior of laboratory-reared and wild Caribbean fruit flies (*Anastrepha suspensa*: Diptera: Tephritidae): 2. Selected physical influences.** *Entomologia Experimentalis et Applicata.* 26(3): 239-244. ISSN: 0013-8703.
NAL Call Number: 421 EN895
Descriptors: *Anastrepha suspense*, Tephritidae, oviposition, site selection, response to site physical characters, spatial environment, oviposition site selection, response to physical factors, reproduction, behavior, abiotic factors, physical factors, Cyclorrhapha, Brachycera, Diptera, true flies.

Leegwater-van der Linden, M.E. (1979) **Recent advances in the rearing of Glossina pallidipes Austen.** *International Symposium on the Use of Isotopes for Research and Control of Vectors of Animal Diseases, Host Pathogen Relationships and the Environmental Impact of Control Procedures, International Atomic Energy Agency , Vienna (Austria)* p. 413-423, Report No : IAEA--SM-240/32 : IAEA--STI/PUB/525. ISBN: 92-0-010080-5.
Notes: Includes discussions; 3 tables; 5 ref. - MICROFICHE NO. 8106539-611-E.
Descriptors: mass rearing, *Glossina pallidipes*, tsetse flies, Diptera.

Otieno, L.H.; Youdeowei, Y. (1979) **Feeding and rearing behavior in tsetse flies.** *International Symposium on the Use of Isotopes for Research and Control of Vectors of Animal Diseases, Host Pathogen Relationships and the Environmental Impact of Control Procedures, International Atomic Energy Agency , Vienna (Austria)* p. 371-380, Report No : IAEA--SM-240/31 : IAEA--STI/PUB/525. ISBN: 92-0-010080-5. Notes: Includes discussions; 2 tables; 14 ref. - MICROFICHE NO. 8106539-611-E.
Abstract: Batwing membrane was used to study salivation and feeding behavior of tsetse flies. Attempts to rear *G. morsitans* artificially through the use of batwing membrane showed that flies needed an initial adjustment period to in vitro maintenance.
Descriptors: mass rearing, feed habits, tsetse flies, Diptera, batwing membrane substrate, salivation.

Prawirodisastro, M.; Benjamin, D.M. (1979) **Laboratory study on the biology and ecology of *Megaselia scalaris* (Diptera: Phoridae).** *Journal of Medical Entomology.* 16(4): 317-320. ISSN: 0022-2585.
NAL Call Number: 421 J828
Descriptors: *Megaselia scalaris*, Phoridae, fecundity, life cycle, duration of stages, environmental factors influence, growth, larval density, temperature effects, population regulation, survival, rearing temperature effect, reproduction, ecology, population dynamics, abiotic factors, physical factors, Cyclorrhapha, Brachycera, Diptera, true flies.

Timischl, W. (1979) **Growth of laboratory populations of tsetse flies: some mathematical Investigations.** *International Symposium on the Use of Isotopes for Research and Control of Vectors of Animal Diseases, Host Pathogen Relationships and the Environmental Impact of Control Procedures, International Atomic Energy Agency , Vienna (Austria)* p. 443-455, Report No : IAEA--SM-240/11 : IAEA--STI/PUB/525. ISBN: 92-0-010080-5. Notes: Includes discussion; 2 tables, graphs; 6 ref.,

MICROFICHE NO. 8106539-611-E.
Descriptors: population growth, mathematical models, tsetse flies, Diptera, laboratory rearing.

Trimble, R.M. (1979) **Laboratory observation on oviposition by the predaceous tree-hole mosquito, *Toxorhynchites rutilus septentrionalis* (Diptera: Culicidae).** *Canadian journal of zoology.* 57(5): 1104-1108. ISSN: 0008-4301.
NAL Call Number: 470 C16D
Descriptors: egg laying behavior, Culicidae, Diptera, entomophagous, fecundity, freshwater environment, predator, reproduction, ethology.

Wetzel, H. (1979) **Rearing of Glossina palpalis palpalis robineau-desvoidy on freeze-dried blood.** *Vienna (Austria), Isotope and radiation research on animal diseases and their vectors; Proceedings series FAO, Joint FAO/IAEA Div. of Atomic Energy in Food and Agriculture, International Atomic Energy Agency , Vienna (Austria)* p. 439-440, Report No : IAEA--SM-240/34 : IAEA--STI/PUB/525. ISBN: 92-0-010080-5. Notes: Includes discussion; Summary only - MICROFICHE NO. 8106539-611-E.
NAL Call Number: SF810 A3I57 1979
Descriptors: mass rearing, tissue cultures, *Glossina palpalis*, tsetse flies, Diptera.

1978

Caldwell, E.T.; Wright, R.E. (1978) **Induction and termination of diapause in the face fly, *Musca autumnalis* (Diptera: Muscidae), in the laboratory.** *The Canadian entomologist.* 110(6): 617-622. ISSN: 0008-347X.
NAL Call Number: 421 C16
Descriptors: diapause, Diptera, environmental factor, *Musca autumnalis*, photoperiod, temperature, laboratory rearing.

Williams, R.W.; Hagan, N.K. (1978) **Atypical laboratory development of the ROCK strain of *Aedes aegypti* (Diptera: Culicidae) involving long submergence for egg hatching and a short pupal period.** *Journal of Medical Entomology.* 15(1): 87. ISSN: 0022-2585.
NAL Call Number: 421 J828
Descriptors: *Aedes aegypti*, Culicidae, life cycle, duration of stages, pupa, effect of altered rearing conditions, delayed hatching, metamorphosis, life cycle and development, hatching, Nematocera, Diptera, true flies.

1977

Brown, R.D.; Aliniazee, M.T. (1977) **Synchronization of adult emergence of the western cherry fruit fly in the laboratory.** *Annals of the Entomological Society of America.* 70(5): 678-680.
NAL Call Number: 420 En82
Descriptors: laboratory rearing, emergence, environment, *Rhagoletis*, temperature, Tephritidae, Diptera.

McLachlan, A.J. (1977) **Density and distribution in laboratory populations of midge larvae (Chironomidae: Diptera).** *Hydrobiologia.* 55(3): 195-199. ISSN: 0018-8158.
NAL Call Number: 410 H992
Descriptors: Chironomidae, territorial behavior, population density, experimental study, larva, freshwater environment, laboratory population, spatial distribution, ecology.

1976

Barnes, J.K. (1976) **Effect of temperature on development, survival, oviposition, and diapause in laboratory populations of *Sepedon fuscipennis* (Diptera: Sciomyzidae).** *Environmental entomology.* 5(6): 1089-1098. ISSN: 0046-225X.
NAL Call Number: QL461 E532
Descriptors: postembryonic development, diapause, environment, egg laying, Sciomyzidae, temperature effects, ecology, laboratory rearing.

Bush, G.L.; Neck, R.W.; Kitto, G.B. (1976) **Screwworm eradication: inadvertent selection for noncompetitive ecotypes during mass rearing.** *Science.* 193(4252): 491-493. ISSN: 0036-8075.
NAL Call Number: 470 SCI2
ABSTRACT: The rapid fixation of a rare allelic form of alpha-glycerol phosphate dehydrogenase is related to a loss of competitive ability in nature of factory-reared screwworm flies. The increase in frequency results from selection for survival under conditions of domestication and rapid development at high constant temperatures in the factory.
Descriptors: Diptera enzymology, glycerolphosphate dehydrogenase metabolism, insect control methods, alleles, environment, flight, gene frequency, kinetics, muscles enzymology, screw worm infection, prevention and control, temperature effects.

Eldridge, B.F.; Johnson, M.D.; Bailey, C.L. (1976) **Comparative studies of two North American mosquito species, *Culex restuans* and *Culex salinarius*: response to temperature and photoperiod in the laboratory.** *Mosquito news.* 36(4): 506-513. ISSN: 0027-142X.
NAL Call Number: 421 M85
Descriptors: North American mosquitoes, Culicidae, postembryonic development, emergence, environment, nutrition, photoperiod effects, reproduction, temperature effects, Diptera, laboratory rearing.

Hoffmann, K.H. (1976) **Organic body constituents of *Protophormia terrae-novae* (Dipt.) from Spitbergen compared with flies from a laboratory stock.** *Decologia.* 23(1): 13-16.
Descriptors: Calliphoridae, chemical composition, environment, sugars, lipids, proteins.

Kuehlhorn, F. (1976) **Investigations for the problem of the wintering behavior of the larvae of *Anopheles claviger meig.* (Diptera: Culicidae) in the Bavarian One Voralpengebiet with consideration of the results of laboratory tests.** *Zeitschrift fur angewandte Zoologie.* 63(4): 393-420. ISSN: 0044-2291.
NAL Call Number: 449.8 Z36
Descriptors: West Germany, Anopheles, Culicidae, dormancy, environment, larva,

temperature, laboratory study.

Mokry, J.E. (1976) **Laboratory studies on the larval biology of *Simulium venustum say* (Diptera: Simuliidae).** *Canadian journal of zoology.* 54(10): 1657-1663. ISSN: 0008-4301.
NAL Call Number: 470 C16D
Descriptors: postembryonic development, environment, larval biology, freshwater environment, Simuliidae, temperature, laboratory studies.

1975

Istock, C.A.; Wasserman, S.S.; Zimmer, H. (1975) **Ecology and evolution of the pitcher-plant mosquito. I. Population dynamics and laboratory responses to food and population density.** *Evolution.* 29(2): 296-312. ISSN: 0014-3820.
NAL Call Number: 443.8 Ev62
Descriptors: mosquito population dynamics, group effect, environment, food supply, Diptera, laboratory study.

1974

Sherif, E.S. (1974) **Laboratory colonization of *Anopheles multicolor camb.* under controlled conditions of temperature and humidity (Diptera: Culicidae).** *Bulletin de la Societe entomologique d'Egypte.* 58: 355-358. ISSN: 0081-0983.
NAL Call Number: 420 EG9
Descriptors: *Anopheles* mosquitoes, rearing, environment, humidity, temperature, laboratory rearing.

1973

Briegel, H.; Kaiser, C. (1973) **Life - span of mosquitoes (Culicidae, Diptera) under laboratory conditions.** *Gerontologia.* 19(4): 240-249.
Descriptors: Culicidae, environment, longevity, diet.

Cavicchi, S. (1973) **A laboratory study on *Ceratitis capitata wied.* II. Mechanisms which regulate the numerical development of a population.** *Bollettino di zoologia.* 40(1): 55-67. ISSN: 0373-4137.
NAL Call Number: 410 B63
Descriptors: intraspecific competition, group effect, environment, fecundity, laboratory population, population productivity, season, ecology, Diptera.

Grunewald, J. (1973) **Die hydrochemical lebenden Zustände der unreifen Stadien von Boophthora Erythrocephala de Geer (Diptera, Simuliidae). 2. Entwicklung einer Technik für das Aufrichten unter experimentellen Bedingungen. [The hydrochemical living conditions of the immature stages of *Boophthora erythrocephala de geer* (Diptera, Simuliidae). 2. Development of a technique for rearing under experimental conditions.]** *Zeitschrift fur Tropenmedizin und*

Parasitologie. 24(2): 232-49. ISSN: 0044-359X. Note: In German.
NAL Call Number: 448.8 Z37
Descriptors: Diptera growth and development, breeding, carbon dioxide analysis, centrifugation, chlorides analysis, culture media, Diptera metabolism, electric conductivity, environment, filtration, hydrogen ion concentration, larva growth and development, magnesium oxide analysis, methods, nitrates analysis, oxygen analysis, plants metabolism, potassium permanganate analysis, silicon dioxide analysis, sulfates analysis, temperature, water metabolism.

Phelps, R.J. (1973) **The effect of temperature on fat consumption during the puparial stages of *Glossina morsitans morsitans westw.* (Dipt., Glossinidae) under laboratory conditions, and its implication in the field.** *Bulletin of entomological research.* 62(3): 423-438. ISSN: 0007-4853.
NAL Call Number: 421 B87
Descriptors: post-embryonic development, environment, temperature, pupa and laboratory study.

1971

Gamal-Eddin, F.M. (1971) **(I) Field and laboratory studies on the life cycle of the blood-sucking, ecto-parasitic fly *Siphona irritans, lin*, in Egypt. (II) Studies on the behavior of the blood-sucking fly *Siphona irritans, lin*. towards some environmental factors, to pave the way for proper control.** *Journal of the Egyptian Veterinary Medical Association.* 31(3/4): 243-250, 251-262. ISSN: 0379-3044.
NAL Call Number: 41.9 Ar1
Descriptors: *Siphona irritans*, Diptera, *Haematobia irritans*, Egypt, Muscidae, parasites, insect vectors, pathogens and biogenic diseases.

1970

Davies, J.B.; Martinez, R. (1970) **Observations on the population dynamics, behavior and maintenance of a laboratory colony of *Culex* (*melanoconion*) *portesi senevet* and *abonnenc*, 1941 (Diptera: Culicidae).** *Journal of Medical Entomology* 7(2): 179-88. ISSN: 0022-2585.
NAL Call Number: 421 J828
Descriptors: *Culex* mosquitoes, growth and development, environment, methods, behavior, laboratory colony.

1968

Nayar, J.K. (1968) **Biology of *Culex nigripalpus theobald* (Diptera: Culicidae). 1. Effects of rearing conditions on growth and the diurnal rhythm of pupation and emergence.** *Journal of Medical Entomology.* 5(1): 39-46. ISSN: 0022-2585.
NAL Call Number: 421 J828
Descriptors: circadian rhythm, *Culex* mosquitoes, metamorphosis biological, environment, laboratory rearing conditions.

Coleoptera

2004

Fuhrer, E. (2004) **Polyploid spermatozoa in *Pityogenes chalcographus* and *Ips typographus* (Coleoptera: Scolytidae).** *European Journal of Entomology.* 101(1): 21-27. ISSN: 1210-5759.
NAL Call Number: QL461 E9884
Descriptors: economic entomology, pest assessment control and management, population genetics and studies, terrestrial ecology, Coleoptera, *Ips typographus, Pityogenes chalcographus, Picea abies,* sperm, reproductive system, polyploidy, spermatozoa, methods and equipment, light microscopy, imaging and microscopy techniques, laboratory techniques, abnormal spermatogenesis, allochthonous sites, allopatric crosses, autochthonous sites, genetics animal, population genetics, environmental biology.

Johnson, S.N.; Read, D.B.; Gregory, P.J. (2004) **Tracking larval insect movement within soil using high resolution X-ray microtomography.** *Ecological Entomology.* 29(1): 117-122. ISSN: 0307-6946.
NAL Call Number: QL461.E4
Descriptors: behavior, terrestrial ecology, Coleoptera, *Sitona lepidus,* clover root weevil, larva, neonate, *Trifolium repens*, X-ray microtomography, laboratory techniques, insect movements, non-invasive methods, plant-insect interactions, soil columns, travel speed, behavioral biology, comparative study, environmental biology.

Lagisz, M.; Wolff, K. (2004) **Microsatellite DNA markers for the ground beetle *Pterostichus oblongopunctatus f.*** *Molecular Ecology Notes.* 4(1): 113-115. ISSN: 1471-8278.
NAL Call Number: QH541.15 .M632
Descriptors: molecular genetics and biophysics, population genetics and studies, terrestrial ecology, Coleoptera, *Pterostichus oblongopunctatus,* ground beetle, microsatellite DNA loci and markers, multiplex polymerase chain reaction, genetic laboratory techniques, heterozygosity in a population, environmental biology.

Merrick, M.J.; Smith, R.J. (2004) **Temperature regulation in burying beetles (*Nicrophorus* spp.: Coleoptera: Silphidae): Effects of body size, morphology and environmental temperature.** *Journal of Experimental Biology.* 207(5): 723-733. ISSN: 0022-0949.
NAL Call Number: 442.8 B77
Descriptors: *Nicrophorus guttula*, *Nicrophorus hybridus,* body size and temperature, thoracic temperature, thermoregulation, activity patterns, comparative field and laboratory study, Circadian activity, whole animal physiology, temperature relationships, locomotion, behaviour.

Narberhaus, I.; Theuring, C.; Hartmann, T.; Dobler, S. (2004) **Time course of pyrrolizidine alkaloid sequestration in Longitarsus flea beetles (Coleoptera, Chrysomelidae).** *Chemoecology.* 14(1): 17-23. ISSN: 0937-7409.
NAL Call Number: No call number available; located in stacks.
Descriptors: biochemistry and molecular biophysics, terrestrial ecology, toxicology,

Coleoptera, *Longitarsus aeruginosus,* flea beetle, *Longitarsus jacobaeae,* elytra, hemolymph, N-oxidizing enzyme, pyrrolizidine alkaloids, dissection experiment, chemical defense, chemoecology, sequestration process, time course, environmental biology.

Pellissier, S.M.; Carmen, P.S. (2004) **Social stimuli affect juvenile hormone during breeding in biparental burying beetles (Silphidae: Nicrophorus).** *Hormones and behavior.* 45(3): 159-167. ISSN: 0018-506X.
NAL Call Number: QP801.H7H64
Descriptors: parental care, environment, juvenile hormone, development, sexual behavior, laboratory study, Coleoptera, breeding behavior, Coleoptera, *Nicrophorus orbicollis.*

Prasifka, J.R.; Heinz, K.M; Winemiller, K.O. (2004) **Crop colonisation, feeding, and reproduction by the predatory beetle, *Hippodamia convergens*, as indicated by stable carbon isotope analysis.** *Ecological entomology.* 29(2): 226-233. ISSN: 0307-6946.
NAL Call Number: QL461.E4
Descriptors: behavior, terrestrial ecology, environmental biology, *Hippodamia convergens,* Coleoptera, *Aphis gossypii,* Homoptera, Malvaceae, methods and equipment, carbon isotope analysis, laboratory techniques, crop colonization, feeding, habitat management, reproduction.

Pratt, S.J.; Reuss, R. (2004) **Scrubbing carbon dioxide prevents overestimation of insect mortality in long-duration static phosphine toxicity assays.** *Journal of Stored Products Research.* 40(2): 233-239. ISSN: 0022-474X.
NAL Call Number: 421 J829
Descriptors: economic entomology, methods and techniques, pest assessment control and management, Coleoptera, *Sitophilus oryzae,* carbon dioxide, toxicity enhancer, phosphine, soda lime, carbon dioxide scrubbing, long-duration static phosphine toxicity assays, bioassay techniques, comparative study, experimental morphology, physiology, pathology.

2003

Omkar, A.; Srivastava, S. (2003) **Predation and searching efficiency of a ladybird beetle, *Coccinella septempunctata linnaeus* in laboratory environment.** *Indian Journal of Experimental Biology.* 41(1): 82-84. ISSN: 0019-5189.
NAL Call Number: 442.8 IN2
Descriptors: economic entomology, Coleoptera, Homoptera, *Coccinella septempunctata*, ladybird beetle, feeding rate, fourth instar, predation behavior, searching efficiency, *Lipaphis erysimi*, mustard aphid.

2002

Rauter, C.M.; Moore, A.J. (2002) **Evolutionary importance of parental care performance, food resources, and direct and indirect genetic effects in a burying beetle.** *Journal of*

Evolutionary Biology. 15(3): 407-417. ISSN: 1010-061X.
NAL Call Number: QH359 J68
Descriptors: direct-indirect genetic covariance, heritability, indirect genetic effects, maternal effects, parental care, reciprocal cross fostering, reproductive success, nestling growth, brood size, *Nicrophorus vespilloides*, environmental influences, maternal inheritance, variance components, energy expenditure, *Onthophagus taurus*, weaning weight, Coleoptera.

2001

Betz, O.; Fuhrmann, S. (2001) **Life history traits in different life forms of predaceous *Stenus* beetles (Coleoptera, Staphylinidae), living in waterside environments.** *Netherlands Journal of Zoology.* 51(4): 371-393. ISSN: 0028-2960.
NAL Call Number: 410 AR27
Descriptors: activity, egg production, energy, allocation, habitat shift, life history, metabolic rate, respiration, Staphylinidae, *Stenus*, trade-off, Coleoptera, egg size, hunting behavior, parental care, evolution, apparatus.

2000

Fox, C.W. (2000) **Natural selection on seed-beetle egg size in nature and the laboratory: variation among environments.** *Ecology.* 81(11): 3029-3035. ISSN: 0012-9658.
NAL Call Number: 410 EC7
Descriptors: Cercidium, natural selection, seed coat resistance, selection differentials, selection intensity, survivorship, *Stator limbatus*, bruchid beetles, pacific salmon, propagule size, Palo Verde, number, plasticity, quality, Coleoptera, evolution.

Grez, A.A.; Villagran, P. (2000) **Effects of structural heterogeneity of a laboratory arena on the movement patterns of adult *Eriopis connexa* and *Hippodamia variegata* (Coleoptera: Coccinellidae).** *European Journal of Entomology.* 97(4): 563-566. ISSN: 1210-5759. Notes: 7 graphs, 2 tables; 18 ref.
NAL Call Number: QL461 E9884
Abstract: We asked if the structural heterogeneity of a laboratory arena differentially affected the abandonment of the plot, residence time, locomotory rate, pause duration and turning rate of adult *Eriopis connexa* and *Hippodamia variegata* (Coleoptera: Coccinellidae). We simulated an increase in heterogeneity by distributing vertically-oriented toothpicks in a circular arena: one control (without toothpicks), one uniform plot (toothpicks every 1 cm) and one random plot (randomly distributed toothpicks). *E. connexa* did not discriminate between plots in their residence time, but *H. variegata* remained longer in the uniform and longest in the random plots. *H. variegata* only stayed longer than *E. connexa* in the random plots. This resulted because adults of *H. variegata* were stationary for longer periods, moved more slowly and less linearly and explored a higher number of toothpicks than adults of *E. connexa* in more heterogeneous environments. Thus, the physical structure of the environment differentially affects the movement patterns of insects. *Eriopis connexa* seems to be less sensitive to structural heterogeneity than *H. variegata*.

Descriptors: Coccinellidae, behavior, movement, environmental factors, Coleoptera, physiological functions.

Sahota, T.S.; Peet, F.G.; Manville, J.F. (2000) **A comment on "feeding and oviposition preferences of white pine weevil (Coleoptera: Curculionidae) on resistant and susceptible sitka spruce clones in laboratory bioassays".** *Environmental Entomology.* 29(6): 1097-1099. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: behavior, terrestrial ecology, pest assessment control and management, Coleoptera, Coniferopsida, *Picea sitchensis*, sitka spruce, *Pissodes*, strobe, white pine weevil, cortical resin canals, density, distribution, feeding behavior, laboratory bioassays, oviposition preferences, comparative behavior, behavioral biology, environmental biology, bioassay.

Salin, C.; Renault, D.; Vannier, G.; Vernon, P. (2000) **A sexually dimorphic response in supercooling temperature, enhanced by starvation, in the lesser mealworm *Alphitobius diaperinus* (Coleoptera: Tenebrionidae).** *Journal of Thermal Biology.* 25(6): 411-418. ISSN: 0306-4565.
NAL Call Number: QP82.2.T4J6
Descriptors: Coleoptera, Tenebrionidae, supercooling, ability, starvation, freezing resistance, bimodality, sex, cold hardiness, terrestrial, Signy Island, tolerance, capacity, survival, houses, mites.

Selcer, K.W. (2000) **Field ecology laboratory: what to do on a rainy day.** *American Zoologist.* 40(6): 1206. ISSN: 0003-1569. Note: Annual Meeting and Exhibition of the Society for Integrative and Comparative Biology, Chicago, Illinois, USA (January 03-07, 2001).
NAL Call Number: 410 AM3
Descriptors: education, terrestrial ecology, Coleoptera, flour beetles, sow bugs, mark-recapture experimental method, Duquesne University, artificial aerial maps, laboratory activities, line intersect studies, migration, plant density, quadrat studies, terrestrial field ecology, environmental biology, comparative and experimental morphology, physiology and pathology.

1998

Muller, J.K.; A.K. Eggert; S.K. Sakaluk (1998) **Carcass maintenance and biparental brood care in burying beetles: are males redundant?** *Ecological entomology.* 23(2): 195-200. ISSN: 0307-6946.
NAL Call Number: QL461.E4
Abstract: 1. Burying beetles inter small vertebrate carcasses that ultimately serve as a food source for their developing young. The male remains with the female on the carcass after the brood has been produced, purportedly to aid in the feeding and protection of larvae. However, numerous laboratory experiments have failed to demonstrate a beneficial effect of the male on the growth and survival of offspring. 2. A potential difficulty with laboratory studies is that beetles are typically held under relatively benign conditions, protected from the biotic and environmental challenges that they normally encounter. In nature, males may enhance offspring survival by aiding the female in

ridding the carcass of mould, and by helping to preserve the carcass through the secretion of antibiotic substances in the beetles' saliva. To examine more rigorously the potential benefits of male parental care, an experiment was conducted under field conditions in which the reproductive output of male-female pairs was compared to that of single females. 3. Beetles were induced to bury carcasses in soil inside rigid plastic tubes that had been inserted into the ground. The experiment was a paired design involving pairs of sisters reproducing in adjacent tubes; one sister reproduced alone, whereas the other reproduced with the assistance of a male. Soil cores were recovered about 1 month later, and examined for viable pupae. 4. There was no significant difference in the number of offspring produced by single females and those reproducing with the assistance of the male, nor was there any significant difference in total brood mass. These results suggest that any benefits of extended male residency on the carcass do not stem from male participation in carcass maintenance or provisioning young.
Descriptors: *Nicrophorus vespilloides*, reproduction, brood care, carcass maintenance, parental investment, males, Coleoptera, field study.

Townsend, M.L.; Johnson, D.T.; Steinkraus, D.C. (1998) **Laboratory studies of the interactions of environmental conditions on the susceptibility of green june beetle (Coleoptera: Scarabaeidae) grubs to entomopathogenic nematodes.** *Journal of Entomological Science.* 33(1): 40-48. ISSN: 0749-8004.
NAL Call Number: QL461.G4
Descriptors: parasitology, Coleoptera, Nematoda, *Cotinis nitida*, green June beetle, grub, parasite, *Heterorhabditis bacteriophora*, *Steinernema feltiae*, *Steinernema glaseri*, host susceptibility, mortality, soil moisture, soil temperature, comparative and experimental morphology, physiology and pathology, comparative and experimental morphology, laboratory study.

1997

Bhuiyan, M.K.; Nishigaki, J. (1997) **Oviposition of the adult cupreous chafer, *Anomala cuprea hope* (Coleoptera: Scarabaeidae), at different water contents of the ovipositing medium under laboratory conditions.** *Applied Entomology and Zoology.* 32(3): 431-436. ISSN: 0003-6862.
NAL Call Number: SB599.A6
Descriptors: oviposition, water content, sawdust, behavior, fecundity, environmental factors, biology, agricultural entomology, *Anomala cuprea*, Scarabaeidae, Coleoptera, insect pests, pathogens and biogenic diseases of plants, behavior and ecology.

Ehlert, R.; Topp, W.; Thiemermann, S.; Brett, B. (1997) **Phenotypic plasticity in *Choleva agilis* to maintain fitness in an unpredictable environment (Coleoptera: Cholevidae).** *Entomologia Generalis.* 21(3): 145-159. ISSN: 0171-8177.
NAL Call Number: QL461.E582
Descriptors: diapause intensity, temperature, photoperiod, reproduction, heritability, *Oncopeltus fasciatus*, adult diapause, photoperiodic induction, life history plasticity, locomotor activity rhythm, reproductive seasonality, age specific mortality in the beetle *Callosobruchus maculates*, biology of aging, large medfly cohorts, life-history evolution, clonal senescence.

Nakano, S.; Nakamura, K.; Abbas, I. (1997) **Survivorship and fertility schedules of a Sumatran phytophagous lady beetle, *Epilachna enneasticta* (Coleoptera, Coccinellidae) under laboratory conditions.** *Applied Entomology and Zoology.* 32(2): 317-323. ISSN: 0003-6862.
NAL Call Number: SB599 A6
Descriptors: development, ecology, environmental biology, physiology, reproductive system, Coleoptera, *Epilachna enneasticta*, Indonesia, fecundity, fertility, laboratory conditions, lady beetle, longevity, population studies, post reproductive period, Sumatra, survivorship, embryology, morphogenesis.

Songa, J.M.; Holliday, N.J. (1997) **Laboratory studies of predation of grasshopper eggs, *Melanoplus bivittatus* (*say*), by adults of two species of *Pterostichus bonelli* (Coleoptera: Carabidae).** *Canadian entomologist.* 129(6): 1151-1159. ISSN: 0008-347X.
NAL Call Number: 421 C16
Descriptors: laboratory study, predation, egg, phytophagous beetles, soils, depth, plant cover, *Melanoplus bivittatus*, Carabidae, *Nicotiana*, environmental factor, predator prey relation, Acrididae, Orthoptera, Coleoptera, Solanaceae.

Todd, C.M.; W. Block (1997) **Responses to desiccation in four coleopterans from sub-Antarctic South Georgia.** *Journal of insect physiology.* 43(10): 905-913. ISSN: 0022-1910.
NAL Call Number: 421 J825
Abstract: Rates of water loss were determined for four Coleoptera species: the herbivores *Hydromedion sparsutum* and *Perimylops antarcticus* (Family Perimylopidae) and the carnivores *Trechisibus antarcticus* and *Oopterus soledadinus* (Family Carabidae) collected during summer from a range of terrestrial habitats at South Georgia. A recording microbalance enabled measurement of individual weight loss with time in < 5% r.h. at 10, 20, 30 and 35 degrees C. Adults of *T. antarcticus* had significantly higher rates of water loss than any other species over all temperatures. Individuals of both herbivores exhibited the slowest water loss rates under the experimental conditions. Within species, rates at 10 or 20 degrees C were slower than at the higher temperatures. Adult *P. antarcticus* had significantly greater amounts of body water than adult *H. sparsutum* for each of the four temperatures. Within species and life-stages of both herbivores, body water contents after drying at 10 degrees C were significantly lower than individuals dried at 30-35 degrees C, but no such differences were observed for the carnivores. At each temperature, rates of water loss were negatively correlated with initial live weight in all four species, but this was not the case within species or between adults and larvae. Maximum survival times during desiccation declined as temperature increased, but did not differ between species at 10 degrees C. Over 30-35 degrees C, survival times of both herbivores were significantly longer than either of the carnivores. Smaller insects (e.g. the carabids) had faster rates of water loss than the larger perimylopids under the same environmental conditions. The latter had greater resistance to desiccation than the former. It is suggested that the larger body water content of *P. antarcticus* enables it to resist desiccation more than the other three species, which correlates with its ecological distribution. Differences in water contents after drying individuals at low and high temperatures may be caused either by the water binding

properties of cells and tissues or by reduction in energy stores in order to maintain metabolism at lower environmental temperatures causing a body weight loss. Whilst both herbivores show some physiological adaptations to drying conditions, it is suggested that the two carnivorous beetles may have adapted behaviorally to the South Georgia environment.
Descriptors: Coleoptera, dehydration physiological, resistance, body water, water content, environmental temperature, survival, species differences, South Georgia Island.

Youm, O. (1997) **Field and laboratory studies on the biology and management of *Rhinyptia infuscata* (*burmeister*), a pest of pearl millet in West Africa.** *Insects in African economy and environment*, p. 52, Entomological Society of Southern Africa. ISBN: 0-620-21415-5.
NAL Call Number: SB935 A35I57 1997
Descriptors: Coleoptera, pearl millet, *Rhinyptia infuscate*, West Africa, Ethiopian region, feeding, mating, population density, rainfall, sexual dimorphism, genetics and cytogenetics, ecology, environmental biology, bioclimatology and biometeorology, nutritional status and methods, reproductive system, physiology and biochemistry, agronomy, comparative and experimental morphology, pathology.

1996

Currie, C.R.; Spence, J.R.; Niemela, J. (1996) **Competition, cannibalism and intraguild predation among ground beetles (Coleoptera: Carabidae): a laboratory study.** *Coleopterists Bulletin.* 50(2): 135-148. ISSN: 0010-065X.
NAL Call Number: 421 C674
Descriptors: behavior, ecology, nutrition, pathology, physiology, reproductive system, Coleoptera, Carabidae, *Pterostichus adstrictus*, *Pterostichus melanarius*, adult, behavior, between-habitat distribution, cannibalism, egg production, interspecific competition, intraguild predation, larva, mortality, population dynamics, reproductive potential, species abundance, survival, environmental biology, nutritional status and methods, comparative and experimental morphology, pathology.

Okello, S.; Reichmuth, C.; Schulz, F.A. (1996) **Laboruntersuchungen auf der Entwicklungsrate auf niedrige relative Feuchtigkeit und der Entwicklungstemperaturbegrenzung auf *Pagiocerus frontalis* (*fab.*) (Spalte, Scolytidae) bei den hohen und niedrigen Temperaturen. [Laboratory investigations on the developmental rate at low relative humidity and the developmental temperature limit of *Pagiocerus frontalis* (*fab.*) (Col., Scolytidae) at high and low temperatures.]** *Anzeiger fuer Schaedlingskunde Pflanzenschutz Umweltschutz.* 69(8): 180-182. ISSN: 0340-7330. Note: In German.
NAL Call Number: 421 An9
Descriptors: climatology, development, economic entomology, physiology, Coleoptera, *Pagiocerus frontalis*, climatology, development, developmental rate, maize pest, relative humidity, temperature limit, environmental biology, bioclimatology and biometeorology, temperature as a primary variable, embryology, morphogenesis, laboratory rearing.

Rohani, P.; Miramontes, O. (1996) **Chaos or quasiperiodicity in laboratory insect**

population? *Journal of Animal Ecology.* 65(6): 847-849. ISSN: 0021-8790.
NAL Call Number: 410 J826
Descriptors: biosynchronization, ecology, mathematical biology, computational biology, models and simulations, physiology, *Tribolium castaneum*, Coleoptera, chaos, flour beetle, laboratory insect population, mathematical biology, population dynamics, quasiperiodicity, statistical methods, circadian rhythms and other periodic cycles, environmental biology, biophysics, biocybernetics, comparative and experimental morphology, physiology and pathology.

Tucic, N.; Gliksman, I.; Seslija, D.; Milanovic, D.; Mikuljanac, S.; Stojkovic, O. (1996) **Laboratory evolution of longevity in the bean weevil (*Acanthoscelides obtectus*).** *Journal of Evolutionary Biology.* 9(4): 485-503. ISSN: 1010-061X.
NAL Call Number: QH359 J68
Descriptors: development, ecology, evolution and adaptation, genetics, morphology, physiology, reproductive system, Coleoptera, *Acanthoscelides obtectus*, delayed senescence, female fecundity, hybrid, long-term selection, male mating ability, pre-adult developmental time, pure line, reproduction, wet adult weight, evolution, genetics and cytogenetics, sex differences, environmental biology, developmental biology, embryology, morphogenesis, comparative and experimental morphology, pathology.

Tuda, M. (1996) **Mechanism for coexistence in the laboratory community of bean-bean weevil-parasitic wasp.** *Japanese Journal of Ecology* 46(3): 313-320. ISSN: 0021-5007.
NAL Call Number: 410 J272
Descriptors: ecology, environmental biology, parasitology, physiology, Coleoptera, Hymenoptera, Leguminosae, beans, bean weevil, wasp, coexistence mechanism, laboratory community, parasitoid, comparative and experimental morphology, pathology.

Veeravel, R.; Baskaran, P. (1996) **Temperature-dependent development, adult longevity, fecundity and feeding potential of two coccinellid predators under laboratory conditions.** *Entomon.* 21(1): 13-18. ISSN: 0377-9335.
NAL Call Number: QL461 E6
Descriptors: ecology, methods and techniques, nutrition, reproductive system, Coleoptera, Homoptera, *Aphis gossypii*, *Coccinella transversalis*, *Menochilus sexmaculatus*, adult longevity, fecundity, feeding, predator, prey, temperature factor, environmental biology, nutritional status and methods, developmental biology, embryology, laboratory rearing.

Warren, C.E.; Wood, D.L.; Seybold, S.J.; Storer, A.J.; Bros, W.E. (1996) **Olfactory responses of *Ips plastographus maritimus lanier* (Coleoptera: Scolytidae) to insect and host-associated volatiles in the laboratory.** *Journal of Chemical Ecology.* 22(12): 2299-2316. ISSN: 0098-0331.
NAL Call Number: QD415.A1J6
Descriptors: behavior, ecology, physiology, sense organs, sensory reception, Coleoptera, *Ips plastographus maritimus*, aggregation pheromone, communication, host and insect volatiles, male, olfactory response, behavioral biology, environmental biology, sense organs, associated structures and functions, biochemistry, comparative and experimental morphology, physiology and pathology, laboratory rearing.

Zhang, X.; Wang, M. (1996) **An ecological study on the laboratory population of cigarette beetle, *Lasioderma serricorne* (*f.*) (Coleoptera: Anobiidae).** *Acta Entomologica Sinica.* 39(4): 383-392. ISSN: 0454-6296. Note: In Chinese.
NAL Call Number: 421 K96
Descriptors: ecology, economic entomology, physiology, Coleoptera, cigarette beetle, *Lasioderma serricorne*, population studies, storage pest, environmental biology, comparative and experimental morphology, pathology.

1995

Barratt, B.I.; Evans, A.A.; Ferguson, C.M. (1995) **Circadian patterns of oviposition and feeding in *Listronotus bonariensis* (*kuschel*) (Coleoptera: Curculionidae) in the laboratory.** *Proceedings of the Forty Eighth New Zealand Plant Protection Conference.* : 219-223. Note: August 8-10, 1995, New Zealand Plant Protection Society, Inc., Rotorua, New Zealand.
Descriptors: agronomy, behavior, biosynchronization, ecology, economic entomology, nutrition, physiology, reproductive system, Coleoptera, Gramineae, Monocotyledones, Angiospermae, Spermatophyta, Plantae, ryegrass, *Listronotus bonariensis*, darkness, photoperiod, circadian rhythms and other periodic cycles, environmental biology, comparative and experimental morphology, pathology.

Bhuiyan, M.K.; Nishigaki, J. (1995) **Effect of different temperatures on the rearing of 1st and 2nd instar larvae of the cupreous chafer, *Anomala cuprea* (*hope*) (Coleoptera: Scarabaeidae) in decomposed cow-dung under laboratory conditions.** *Applied Entomology and Zoology.* 30(3): 401-406. ISSN: 0003-6862. Notes: 2 tables; 3 fig.; 18 ref.
NAL Call Number: SB599 A6
Descriptors: *Anomala cuprea*, laboratory rearing techniques, environmental temperature, larvae, cows, farmyard manure, agricultural wastes, developmental stages, Bovidae, Bovinae, cattle, Coleoptera, developmental stages, domestic species, environmental factors, experimentation, livestock, mammals, ruminants, Scarabaeidae.

Hammond, R.B.; L.W. Bledsoe; M.N. Anwar (1995) **Maturity and environmental effects on soybeans resistant to Mexican bean beetle (Coleoptera: Coccinellidae).** *Journal of economic entomology.* 88(1): 175-181. ISSN: 0022-0493.
NAL Call Number: 421 J822
Abstract: Entomologists and breeders have met with limited success in the development and release of insect resistant soybean cultivars. Although numerous germplasm lines resistant to defoliating insects have been released, only three cultivars have been made available to growers over the past 20 yr. Researchers have examined potential limitations of insect resistant soybeans, with most of the studies examining the negative impact of plant maturity. This study examined the relative resistance levels of four advanced germplasm lines during the vegetative, flowering, and pod-fill growth stages of soybean development. Resistance was measured by rearing Mexican bean beetle, *Epilachna varivestis mulsant*, on excised, field-grown leaves and comparing larval mortality and developmental periods. The study was conducted in two locations for 2 yr. In the 1st yr, mortality was significantly greater, and developmental periods lengthened, on the four

resistant soybean lines compared with two susceptible cultivars during the vegetative and flowering stages; however, these differences were slight to nonexistent during the pod-fill stage. Although similar differences were evident the 2nd yr, the levels of resistance were greatly lowered. This reduction in resistance as the plants matured is comparable to that found by other researchers. The loss of resistance in the 2nd yr was unexpected and was attributed to much higher than normal rainfall in July at both locations. We discuss the consequences of lower levels of resistance in maturing plants and under conditions of high rainfall, both for breeding programs and field resistance as required by growers.
Descriptors: Coleoptera, Coccinellidae, Mexican bean beetle, *Glycine max*, soybean cultivars, pest resistance, varietal susceptibility, *Epilachna varivestis*, developmental stages, biological development, mortality, crop growth stage, environmental factors, genotype environment interaction, insect control, Ohio, Indiana, laboratory reared insects.

Kistler, R.A. (1995) **Influence of temperature on populations within a guild of mesquite bruchids (Coleoptera: Bruchidae).** *Environmental entomology.* 24(3): 663-672. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Abstract: The effect that harsh, variable desert temperatures might have on the structure and population dynamics of a guild of Bruchidae (Coleoptera) that feed in the seeds of mesquite, *Prosopis velutina wooten*, was examined in a 3-yr field and laboratory study. Metabolic rate, fecundity, longevity, developmental times, survivorship, and body size were measured across the temperature spectrum in which the species normally live. The 4 species that compose the guild-*Algarobius prosopis* (LeConte), *Mimosestes amicus* (Horn), *Mimosestes protractus* (Horn), and *Neltumius arizonensis* (Schaeffer) divide the use of the resource temporally. The first 2 species dominate resource use and overlap entirely in time, whereas the 2 latter minor species utilize opposite ends of the temporal resource spectrum. Of the two dominants, *M. amicus* functions as a physiological generalist, apparently sacrificing resource adaptation for greater temperature adaptation and very high reproductive output. In contrast, *A. prosopis* is well adapted to both the use of mesquite as a resource and also to the desert thermal environment. The 2 minor species seem to be less well adapted to both the resource and the environment. Temperature clearly plays a strong role in determining the structure of this guild of bruchids.
Descriptors: Bruchidae, *Prosopis velutina*, population ecology, community ecology, air temperature, life history, phenology, population dynamics, species differences, desert insects, Arizona.

Krooss, S. (1995) **Survival of a predatory beetle in an agricultural landscape: a comparison of laboratory and field observations on *Ocypus similis* (Coleoptera: Staphylinidae).** *Zoologische Beitraege.* 35(2): 185-197. ISSN: 0044-5150. Note: In German.
NAL Call Number: 410 Z753
Descriptors: climatology, ecology, physiology, Coleoptera, *Ocypus similes*, pupation, seasonality, temperature, environmental biology, bioclimatology and biometeorology, temperature as a primary variable, developmental biology, embryology, morphogenesis, laboratory study, field study.

Kuno, E.; Kozai, Y.; Kubotsu, K. (1995) **Modelling and analyzing density-dependent population processes: comparison between wild and laboratory strains of the bean weevil, *Callosobruchus chinensis* (*l.*).** *Researches on Population Ecology (Kyoto).* 37(2): 165-176. ISSN: 0034-5466.
NAL Call Number: 420 K99
Descriptors: development, economic entomology, evolution and adaptation, mathematical models and simulations, physiology, reproductive system, Coleoptera, bean weevil, *Callosobruchus chinensis*, adult, density-dependent population processes, domestication, egg survival, environmental biology/ecology, evolution, laboratory strain, larval survival, oviposition, selection pressure, stored beans, wild strain, biophysics, biocybernetics, comparative study, pathology.

Pelletier, Y. (1995) **Recognition of conspecific eggs by female Colorado potato beetles (Coleoptera: Chrysomelidae).** *Environmental entomology.* 24(4): 875-878. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Abstract: In its natural environment, the Colorado potato beetle, *Leptinotarsa decemlineata* (*say*), colonizes plants that are distributed in patches. In such conditions, females must select oviposition sites that will provide sufficient resources for the survival of their offspring. The presence of conspecific eggs on the plant reduces the amount of resources available, so the density of conspecific eggs must be evaluated. In the laboratory, most females laid their eggs on the terminal leaflet of the highest of 3 leaves available to them. Feeding damage did not seem to modify the process of oviposition, and the presence of eggs did not change feeding patterns. In choice tests, egg clutches, hexane-washed eggs, yellow paper, and green paper reduced deposition of eggs on the treated leaflet, whereas hexane, white paper, and egg extract did not. Conspecific egg perception using visual cues, and possibly other stimuli, was demonstrated.
Descriptors: *Leptinotarsa decemlineata*, oviposition, beetle behavior, ova, perception, females.

Tucic, N.; Milanovic, D.; Mikuljanac, S. (1995) **Laboratory evolution of host plant utilization in the bean weevil (*Acanthoscelides obtectus*).** *Genetics Selection Evolution.* 27(6): 491-502. ISSN: 0999-193X.
NAL Call Number: QH431 A1A52
Descriptors: behavior, development, ecology, evolution and adaptation, physiology, population genetics and studies, reproductive system, Coleoptera, Leguminosae, Dicotyledones, Angiospermae, Spermatophyta, *Acanthoscelides obtectus*, *Cicer arietinum*, *Phaseolus vulgaris*, artificial selection, egg-to-adult viability, host seed preference, larval density, natural selection, oviposition preference, cytogenetics, environmental biology, developmental biology, embryology, morphogenesis, comparative and experimental morphology, physiology and pathology, biochemistry and biophysics.

1994

Barker, J.F.; Charlet, L.D. (1994) **Post-diapause development of the sunflower stem weevil *Cylindrocopturus adspersus* (*leconte*) under controlled laboratory conditions.** *Journal

of the Kansas Entomological Society. 66(4): 414-419. ISSN: 0022-8567.
NAL Call Number: 420 K13
Descriptors: agronomy, climatology, economic entomology, pathology, physiology, reproductive system, Coleoptera, *Cylindrocopturus adspersus*, adult, genital development, mortality, reproductive physiology, seasonality, sunflower pest, temperature, ecology, environmental biology, bioclimatology and biometeorology, external effects, temperature as a primary variable, necrosis, anatomy, biochemistry, developmental biology, embryology, morphogenesis, comparative and experimental morphology.

Casteels, H.; Miduturi, J.S.; Moermans, R.; De Clercq, R. (1994) **Laboratory studies on the oviposition and adult-longevity of the black vine weevil *Otiorhynchus sulcatus f.*** *Mededelingen Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen Universiteit Gent.* 59(2A): 189-195.
Descriptors: ecology, economic entomology, reproductive system, Coleoptera, Spermatophyta, *Otiorhynchus sulcatus*, fecundity, greenhouse pest, environmental biology, physiology and biochemistry, developmental biology, embryology, morphogenesis, pathology, circadian rhythms and other periodic cycles, bioclimatology and biometeorology, laboratory study.

Evans, K.A.; Allen-Williams, L.J. (1994) **Laboratory and field response of the pollen beetle, *Meligethes aeneus*, to the odour of oilseed rape.** *Physiological entomology.* 19(4): 285-290. ISSN: 0307-6962.
NAL Call Number: QL461.P5
Descriptors: behavior, ecology, economic entomology, physiology, sense organs, sensory reception, Coleoptera, Cruciferae, *Brassica napus*, *Meligethes aeneus*, flower odor, host-plant location, leaf odor, mark-release-recapture, odor-mediated anemotaxis, olfactometer, environmental biology, associated structures and functions, comparative and experimental morphology, pathology, laboratory study, field study.

Fisher, J.R.; J.J. Jackson; A.C. Lew (1994) **Temperature and diapause development in the egg of *Diabrotica barberi* (Coleoptera: Chrysomelidae).** *Environmental entomology.* 23(2): 464-471. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Abstract: Three independent studies were conducted on the effects of constant temperatures (0, 3, 6, 9, 12, 15, 18, and 25° C) with numerous exposure times (15 to 240 d) on diapausing embryos of the northern corn rootworm, *Diabrotica barberi smith* and *lawrence*. All three studies had similar results. The temperatures 15 and 18 degrees C appeared to enhance diapause development and subsequent diapause termination when compared with the lower temperatures (0-3 degrees C). However, the temperature range 9-12 degrees C was optimum for minimum mortality and maximum hatch at nearly all exposure times used. At this range and in particular 9 degrees C, hatch was as high as 60% after 180 d exposure. Exposures of 15 and 30 d produced minimal hatch, < 20%, at any temperature. Days to hatch tended to decrease as temperature increased but varied with experiment. Hatching time also decreased as exposure increased for all temperatures. Eggs exposed only to the developmental optima of 25 degrees C had < 20% hatch in all studies, and greater than or equal to 50% of the eggs were still in the

diapause state at the conclusion of the studies. We concluded that most *D. barberi* embryos require low temperature to terminate diapause and complete embryogenesis. These studies support the hypothesis that *D. barberi* has a propensity to be continuously variable in diapause length. Also, variable diapause length has allowed this species to adapt to natural and artificial perturbations, in particular, crop rotation.
Descriptors: *Diabrotica barberi*, ova, various temperature effects, diapause, embryonic development, laboratory study.

Evans, K.A.; Allen-Williams, L.J. (1994) **Laboratory and field response of the pollen beetle, *Meligethes aeneus*, to the odour of oilseed rape.** *Physiological entomology.* 19(4): 285-290. ISSN: 0307-6962.
NAL Call Number: QL461.P5
Descriptors: behavior, ecology, environmental biology, economic entomology, physiology, sense organs, sensory reception, Coleoptera, Cruciferae, Dicotyledones, Angiospermae, Spermatophyta, *Brassica napus*, *Meligethes aeneus*, flower and leaf odor, host-plant location, mark-release-recapture, odor-mediated anemotaxis, olfactometer, comparative and experimental morphology, pathology.

Hernandez, J.M. (1994) **El ciclo biológico de una cierta especie de Cerambycidae en laboratorio condiciona (Coleóptero). [Biological cycle of some Cerambycidae species in laboratory conditions (Coleoptera).]** *Boletin de la Asociacion Espanola de Entomologia* 18(1-2): 15-20. ISSN: 0210-8984. Note: In Spanish.
NAL Call Number: QL482.S8B65
Descriptors: behavior, development, ecology, environmental biology, nutrition, physiology, reproductive system, Coleoptera, *Iberodorcadion hispanicum*, artificial breeding, artificial diet, immature stages, oviposition, nutrition, biochemistry, embryology, morphogenesis.

Throne, J.E. (1994) **Life history of immature maize weevils (Coleoptera: Curculionidae) on corn stored at constant temperatures and relative humidities in the laboratory.** *Environmental entomology.* 23(6): 1459-1471. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Abstract: Life history of immature maize weevils, *Sitophilus zeamais motschulsky*, was studied at 10-40˚ C and 43-76% RH. The optimal quantity of corn for minimizing density effects and the optimal observation frequency for minimizing disturbance effects were determined at 30˚ C and 75% RH. The quantity of corn (32-256 g) provided to five females ovipositing for 24 h did not affect duration of development, but the number of progeny produced increased asymptotically as the quantity of corn provided increased. Frequency of observation (from 1- to 14-d intervals) did not affect duration of development or number of progeny produced. Using moisture contents measured in the life history study, an equation was developed for predicting equilibrium moisture content of corn from temperature and relative humidity. Duration of immature development did not vary with sex, but did vary with test. This suggests that insect strain or chemical composition of the corn must be included as factors in a model predicting effects of environment on duration of immature development. Survival from egg to adult emergence was greatest at 95˚ C. Sex ratio of emerging adults did not differ from 1:1. The number of multiply-infested kernels was low at all environmental conditions, and

survival from egg to adult emergence in these kernels averaged 18%. Maximum daily rate of fecundity, duration of development, and number of progeny produced were optimal at 30° C and 75% RH. An index of environmental suitability indicated that 30° C and 75% RH was the optimal environment for growth of maize weevil populations on corn. Implications of the results for managing maize weevil populations are discussed. Descriptors: maize, temperature and relative humidity effects, *Sitophilus zeamais*, stored corn products pests, ova, larvae, biological development, progeny, fecundity, life history.

1993

Gu, Z.; Zhang, X. (1993) **Influence of temperature on the growth of laboratory population of the drugstore beetle (*Stegobium paniceum*).** *Journal of Nanjing Agricultural University.* 16(1): 33-37. ISSN: 1000-2030. Notes: 3 ill., 3 tables, 3 ref., In Chinese.
NAL Call Number: S19 N35
Descriptors: *Stegobium*, stored products pests, temperature effects, growth rate, developmental stages, oviposition, Anobiidae, biological development, Coleoptera, environmental factors, growth, pests, physiological functions, sexual reproduction.

Lactin, D.J.; Holliday, N.J.; Lamari, L.L. (1993) **Temperature dependence and constant-temperature diel aperiodicity of feeding by Colorado potato beetle larvae (Coleoptera: Chrysomelidae) in short-duration laboratory trials.** *Environmental Entomology.* 22(4): 784-790. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: temperature effects, insect pests, potatoes, biology, environmental factors, feeding, agricultural entomology, Coleoptera, Chrysomelidae, Leptinotarsa, Decemlineata, *Solanum tuberosum*, pests, pathogens and biogenic diseases of plants, laboratory studies.

Lozano, C.; Campos, M. (1993) **Laboratory-rearing of *Hylesinus varius* (Col.: Scolytidae).** *Mitteilungen der Schweizerischen Entomologischen Gesellschaft.* 66(3-4): 317-322. ISSN: 0036-7575.
NAL Call Number: 420 SW6
Descriptors: ecology, nutrition, physiology, reproductive system, Coleoptera, Oleaceae, *Hylesinus varius*, habitat, reproduction, environmental biology, nutritional status and methods, biochemistry, comparative and experimental morphology, laboratory studies.

Nilsson, J.A.; Johnson, C.D. (1993) **Laboratory hybridization of *Stator beali* and *S. limbatus*, with new host records for *S. limbatus* and *Mimosestes amicus* (Coleoptera: Bruchidae).** *Southwestern Naturalist.* 38(4): 385-387. ISSN: 0038-4909.
NAL Call Number: 409.6 So8
Descriptors: biogeography, population studies, ecology, environmental biology, evolution and adaptation, physiology, reproductive system, Coleoptera, *Mimosestes amicus*, *Stator beali*, *Stator limbatus*, Mexico, North America, Texas, USA, behavior, diet, geographic distribution, reproduction, speciation, nutritional status and methods, comparative and experimental morphology, hybridization.

Victor, R.; Ojaruega, E. (1993) **Humidity responses of the maize weevil *Sitophilus zeamais***

***motsch* (Coleoptera; Curculionidae) under laboratory conditions.** *African Journal of Ecology.* 31(4): 337-342. ISSN: 0141-6707. Notes: 17 ref.
NAL Call Number: 409.6 Ea7
Descriptors: stored products pests, humidity, behavior, cereals, agricultural products, *Sitophilus zeamais*, Nigeria, biology, environmental factors, Anglophone, chemicophysical properties, Coleoptera, Curculionidae, laboratory studies, plant products, West Africa.

Weissling, T.J.; R.M. Giblin-Davis (1993) **Water loss dynamics and humidity preference of *Rhynchophorus cruentatus* (Coleoptera: Curculionidae) adults.** *Environmental entomology.* 22(1): 93-98. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Abstract: The water loss dynamics and humidity preference of *Rhynchophorus cruentatus* (*f.*) adults were investigated. Total body water averaged 47 +/- 8% by mass, and cumulative loss increased with time at all humidities tested (0, 33, 63, and 100% RH) at 30˚ C. Death occurred more rapidly in low than in high humidities, at which time weevils had lost approximately 50% of their total body water. Cuticular permeability of weevils calculated from exposure to 0% RH for 2 h was 39.5 +/- 4.1 and 75.9 +/- 8.1 micrograms cm-2 h-1 mmHg-1 when surface areas were calculated using Meeh's formula and planimetry, respectively. When given a choice, *R. cruentatus* adults chose high over low relative humidity after exposure for 2 and 24 h. *R. cruentatus* adults are subject to desiccation under a drying environment and may use habitat location to conserve water.
Descriptors: Palmae, sabal palmetto, stress, susceptibility, *Rhynchophorus*, longevity, water loss dynamics, water relations, mortality, relative humidity and preferences, temperature, Florida.

Weissling, T.J.; Giblin-Davis, R.M.; Schefffrahn, R.H. (1993) **Laboratory and field evidence for male-produced aggregation pheromone in *Rhynchophorus cruentatus* (*f.*) (Coleoptera: Curculionidae).** *Journal of Chemical Ecology* 19(6): 1195-1203. ISSN: 0098-0331.
NAL Call Number: QD415 A1 J6
Descriptors: behavioral biology, biochemistry and molecular biophysics, ecology, environmental biology, endocrine system, chemical coordination and homeostasis, physiology, Coleoptera, Lepidoptera, Oleaceae, Palmae, forest tent caterpillar, *Fraxinus pennsylvanica var. subintegerrinia*, *Malacosoma disstria*, alterable resistance, bioassay, defensive chemistry, environmental biology, biochemical studies, endocrine system, comparative and experimental morphology, laboratory studies, field studies.

1992

Berlov, O.E.; Berlov, E.Y. (1992) Биология **lopatini Carabus (Coleoptera, Carabidae)** в лаборатории.**[Biology of *Carabus lopatini* (Coleoptera, Carabidae) in a laboratory.]** *Zoologicheskii Zhurnal.* 71(6): 151-153. ISSN: 0044-5134. Note: In Russian.
NAL Call Number: 410 R92
Descriptors: development, ecology, physiology, Coleoptera, *Carabus lopatini*, behavior, environmental biology, developmental biology, embryology, morphogenesis, zoology,

comparative and experimental morphology, pathology.

de Kort, C.A; Koopmanschap, A.B.; Mauchamp, B.; Couillaud, F.; Baehr, J.C. (1992) **Identification and characterization of haemolymph proteins of the Colorado potato beetle, reared under different photoregimes.** In: *Insect juvenile hormone research. Fundamental and applied approaches. Chemistry, biochemistry and mode of action.* INRA , Paris (France) p. 165-171. ISBN: 2-7380-0428-8.
Descriptors: *Leptinotarsa decemlineata*, pests, hemolymph, vitellogenins, proteins, juvenile hormones, photoperiodicity, endocrine glands, physiological regulation, morphology, body fluids, Chrysomelidae, Coleoptera, environmental factors, regimes, lighting, lipoproteins, noxious insects, physiological functions, proteins, sesquiterpenoids, beetles.

Grosman, D.M.; Salom, S.M.; Payne, T.L. (1992) **Laboratory study of conspecific avoidance by host-colonizing *Dendroctonus frontalis zimm*. (Coleoptera: Scolytidae).** *Journal of Insect Behavior.* 5(2): 263-271. ISSN: 0892-7553.
URL: http://www.wkap.nl/journalhome.htm/0892-7553
NAL Call Number: QL496.J68
Descriptors: insect environments, social density, beetles, host colonization, conspecific avoidance and gallery construction, southern pine beetles, social and instinctive behavior, laboratory study.

Haynes, J.W.; Smith, J.W. (1992) **Longevity of laboratory-reared boll weevils (Coleoptera: Curculionidae) offered honey-bee-collected pollen and plants unrelated to cotton.** *Journal of Entomological Science.* 27(4): 366-374. ISSN: 0749-8004.
NAL Call Number: QL461 G4
Descriptors: insect aging, ecology, environmental biology, economic entomology, nutrition, Coleoptera, Compositae, Malvaceae, Angiospermae, Onagraceae, Primulaceae, Rosaceae, *Anthonomus grandis*, *Oenothera speciosa*, *Sonchus asper*, *Taraxacum officinale*, sucrose, control, eradication, food, mortality, pollen, survival, nutritional status and methods, behavioral biology.

Loia, M. (1992) **Influenza di alcuni fattori (temperatura ed alimentarsi) sull'elevazione dei cardinalis di Rodolia (mulsant) (Coleottero: Coccinellidae). [Influence of some factors (temperature and feeding) on the rearing of *Rodolia cardinalis* (*mulsant*) (Coleoptera: Coccinellidae).]** *Bollettino del Laboratorio di Entomologia Agraria Filippo Silvestri di Portici.* 49: 69-84. ISSN: 0304-0658. Notes: 11 tables; 11 ref., In Italian.
NAL Call Number: 420 P82B
Abstract: The influence of temperature and feeding on some important biological characteristics (longevity, preovideposition period, fecundity, lenght of cycle egg-adult) of *Rodolia cardinalis* (*mulsant*) (Coleoptera: Coccinellidae) has been investigated. On the basis of the achieved results, a rearing plan and storage is suggested to keep a stock culture of *R. cardinalis* at low cost, up to 220-240 days, managing temperature and food. This allows to maintain easily R. cardinalis during winter and to retard the normal laboratory rearing in spring, when the outside conditions are favourable to make distributions of the predator, if necessary.

Descriptors: Campania, *Rodolia cardinalis*, predators, environmental temperature, stock culture, costs, diet, biological control organisms, mass rearing, *Icerya purchasi*, honey, insect products, Coccinellidae, Coccoidea, Coleoptera, environmental factors, Europe, Hemiptera, Homoptera, honeycomb extracts, Icerya, Italy, Margarodidae, Mediterranean countries, natural enemies, rearing techniques, *Sternorrhyncha*, temperature, Western Europe.

Taberner, A.; Castanera, P. (1992) **Estudios en las condiciones del laboratorio de la biología de los mariaefranciscae de *Aubeonymus*, parásito de la remolacha. [Studies in laboratory conditions of the biology of *Aubeonymus mariaefranciscae*, a pest of the sugar beet.]** *Boletim da Sociedade Portuguesa de Entomologia.* 0(139): 221. ISSN: 0870-7227. Note: Conference/Meeting: Fifth Iberian Congress of Entomology, Lisbon, Portugal, November 9-13, 1992; In Spanish.
NAL Call Number: QL482.P8B85
Descriptors: agronomy, biosynchronization, climatology, ecology, economic entomology, nutrition, physiology, Chenopodiaceae, Coleoptera, *Aubeonymus mariaefranciscae*, Spain, biological cycle, meeting abstract, phenology, circadian rhythms and other periodic cycles, environmental biology, nutritional status and methods, comparative and experimental morphology, laboratory study.

Varavdekar, V.R.; Dumbre, R.B. (1992) **Laboratory studies on bionomics and host preference of *Raphidopalpa* spp. in Maharashtra.** *Journal of Maharashtra Agricultural Universities.* 17(2): 254-257. ISSN: 0378-2395.
NAL Call Number: S471 I3J6
Descriptors: biosynchronization, ecology, environmental biology, economic entomology, horticulture, physiology, reproductive system, toxicology, Cucurbitaceae, Coleoptera, *Raphidopalpa atripennis*, *Raphidopalpa cincta*, *Raphidopalpa foveicollis*, India, fecundity, hibernation, longevity, mating, musk, melon, pumpkin beetles, reproduction, ridge gourd, behavioral biology, temperature: measurement, effects and regulation-thermorhythms, host preferences.

1991

Chandler, L.D.; Wright, J.E. (1991) **Longevity of the boll weevil (Coleoptera: Curculionidae) on cotton and alternate feeding sources under various temperature regimes in the laboratory.** *Journal of Economic Entomology.* 84(6): 1699-1704. ISSN: 0022-0493.
NAL Call Number: 421 J822
Descriptors: fibre plants pest, temperature, environmental factors, biology, longevity, cotton, Kenaf, Okras, agricultural entomology, Coleoptera, Curculionidae, *Anthonomus grandis*, Malvaceae, *Hibiscus rosa-sinensis*, *Gossypium*, *Hibiscus cannabinus*, *Abelmoschus esculentus*.

Ebina, J.; Nakajima, S.; Adachi, M.; Matsuno, K. (1991) **Rearing experiments of the larvae of *Luciola cruciata* in the laboratory.** *Kyoto Prefectural Institute of Hygienic and Environmental Sciences.* 36: 71-78. ISSN: 0389-5041. Note: Journal Number: Z0977AAA, Kyoto fu Eisei Kogai Kenkyujo Nenpo (Annual Report of Kyoto Prefectural Institute of Hygienic and Environmental Sciences).

Descriptors: Lampyridae, larvae, breeding, rearing, pH dependence, feeding, food intake, growth promotion, habitat environment, growth stage, behavior, growth regulation, laboratory study, Coleoptera.

Eidmann, H.H.; Kula, E.; Lindeloew, A. (1991) **Host recognition and aggregation behavior of *Hylastes cunicularius erichson* (Col., Scolytidae) in the laboratory.** *Journal of applied entomology.* 112(1): 11-18. ISSN: 0931-2048.
NAL Call Number: 421 Z36
ABSTRACT: Host recognition and aggregation behavior in the black spruce beetle, *Hylastes cunicularius erichson*, were studied in choice experiments in the laboratory. The beetles tended to aggregate. Aggregation occurred at host material or at beetles and was independent of the sex of the beetles. Hidden host material was found by active host orientation. The beetles were attracted by several conifer species. In some experiments the beetles preferred the main host, Norway spruce, but Scots pine was also readily accepted. Sections of roots were chosen more often than stem sections. Fresh cuts on the host material enhanced attraction. No evidence was found to indicate the presence of an aggregation pheromone.
Descriptors: *Pinus sylvestris*, *Picea abies*, *Hylastes*, orientation, Coleoptera, environmental factors, Pinaceae, Scolytidae, host recognition, aggregation behavior, laboratory studies, conifer species choices, roots and stems.

Roberts, C.S.; Seely, M.K.; Mitchell, W.D.; Campbell, J.D. (1991) **Body temperatures of Namib Desert tenebrionid beetles: their relationship in laboratory and field.** *Physiological entomology.* 16(4): 463-475. ISSN: 0307-6962.
NAL Call Number: QL461.P5
Descriptors: temperature, biology, physiology, environmental factors, agricultural entomology, Coleoptera, Tenebrionidae, Namibia, insect pests, biochemistry, laboratory study, field study.

Summerlin, J.W.; Meola, S.M.; Fincher, G.T.; Roth, J.P. (1991) **Laboratory observations on the life cycle of *Phelister panamensis leconte* (Coleoptera: Histeridae) including scanning electron microscopy of the life stages.** *Journal of agricultural entomology.* 8(3): 189-197. ISSN: 0735-939X.
NAL Call Number: SB599 J69
Descriptors: insect life cycle, laboratory study, temperature, humidity, egg laying, embryonic development, scanning electron microscopy, Histeridae, *Haematobia irritans*, predator, entomophagous, environmental factors, Coleoptera, laboratory study.

Yamashita, N.; Hayakawa, H. (1991) **[Studies on mass rearing methods of the dung beetle, *Onthophagus gazella*, 7: effect of photoperiod condition on fertility of *Onthophagus gazelle*.]** *Annual Report of the Society of Plant Protection of North Japan.* (42): 175-176. ISSN: 0368-623X. Notes: 1 table, In Japanese.
NAL Call Number: 464.9 K64
Descriptors: *Onthophagus gazelle*, mass rearing methods and techniques, fertility, photoperiodicity, environmental factors, light regimes, oviposition, biological properties, Coleoptera, lighting, physiological functions, rearing techniques, Scarabaeidae, sexual reproduction.

1990

Donahaye, E. (1990) **Laboratory selection of resistance by the red flour beetle, *Tribolium-castaneum* (*herbst*), to a carbon dioxide-enriched atmosphere.** *Phytoparasitica.* 18(4): 299-308. ISSN: 0334-2123.
NAL Call Number: SB599 P53
Descriptors: *Tribolium castaneum*, red flour beetle, carbon dioxide, atmosphere, laboratory study.

Donahaye, E. (1990) **Laboratory selection of resistance by the red flour beetle, *Tribolium castaneum* (*herbst*), to an atmosphere of low oxygen concentration.** *Phytoparasitica.* 18(2): 189-202. ISSN: 0334-2123.
NAL Call Number: SB599 P53
Descriptors: stored food products pests, oxygen, environmental factors, biology, hypoxia, resistance, agricultural entomology, CAS Registry Numbers: 7782-44-7, Tenebrionidae, Coleoptera, *Tribolium castaneum*, biodeterioration, laboratory study.

Gonzalez, R.; Campos, M. (1990) **Laboratory rearing of *Phloeotribus scarabaeoides* (Bernard, 1788).** *Boletin de sanidad vegetal-plagas.* 16(1): 355-361. ISSN: 0213-6910.
NAL Call Number: SB950 A1S7
Descriptors: beetle rearing, laboratory study, reproduction, temperature, humidity, rearing medium, pest, host plant, oil plant, vegetal, environmental factor, *Olea europaea*, Scolytidae, Coleoptera, olive bark beetle.

Masuzawa, T. (1990) **Comparison of reproductive performance of the female adults between the two phytophagous lady birds, *Epilachna vigintioctomaculata* and *E. niponica* (Coleoptera: Coccinellidae) at different rearing temperatures.** *Journal of the Faculty of Agriculture - Shinshu University.* 27(2): 43-48. ISSN: 0583-0621. Notes: 2 tables; 1 fig.; 10 ref., In Japanese.
NAL Call Number: 107.6 M41
Abstract: In order to investigate a difference in number of eggs laid per female adult, and effect of temperature on reproduction and surviving period of female adults between *Epilachna vigintioctomaculata* (Ev hereafter) and *E. niponica* (En hereafter). One-pair rearing of the two species was done in the laboratory at different temperatures (20, 25 and 30° Centigrade). The results were as follows. [Ev] There was no significant difference in the number of eggs laid and the number of egg masses per female adult among three temperatures. However, the surviving period of female adults became longer at 20° Centigrade and shorter at 30° Centigrade, and the number of eggs per mass became larger at 20° Centigrade and the lowest at 30° Centigrade. It was conceivable that temperatures of 20° Centigrade and 25° Centigrade were suitable for reproduction and surviving of female adult of Ev and that of 30° Centigrade C was unsuitable. [Ev] The number of eggs laid and the number of egg masses per female adult became larger and surviving period of female adult was longer at 20° Centigrade and 25° Centigrade. Further, the index of fecundity was the highest at 25° Centigrade and the lowest at 30° Centigrade. So, it might be considered that temperatures of 20° Centigrade and 25° Centigrade were suitable for reproduction and surviving of female adult of En. It seemed that temperature of 30° Centigrade was unsuitable for reproduction and surviving of Ev.

From the comparison of these results of the two species, it became clear that there was a difference in reproductive performance between the two species. It is conceivable that the difference in reproductive performance between the two species becomes an important factor responsible for population density of the two species in the field.
Descriptors: *Epilachna*, reproductive performance, females, three environmental temperatures, biological properties, Coccinellidae, Coleoptera, numbers of eggs laid, laboratory study.

Takeda, M. (1990) **Studies on the fecundity and feeding activity of the overwintered adults of the rice water weevil, *Lissorhoptrus oryzophilus kuschel*, (Coleoptera: Curculionidae), under laboratory conditions, 1: effect of temperature.** *Annual Report of the Society of Plant Protection of North Japan.* (41): 102-104. ISSN: 0368-623X.
Notes: 1 table; 4 fig.
NAL Call Number: 464.9 K64
Descriptors: *Oryza sativa*, *Lissorhoptrus oryzophilus*, behavior, fertility, laboratory experimentation, environmental temperature, biological properties, Coleoptera, Curculionidae, Gramineae, reproductive success.

1989

Hassell, M.P.; Taylor, V.A.; Reader, P.M. (1989) **The dynamics of laboratory populations of *Callosobruchus chinensis* and *C. maculatus* (Coleoptera: Bruchidae) in patchy environments.** *Researches on population ecology.* 31(1): 35-51. ISSN: 0034-5466.
NAL Call Number: 420 K99
Descriptors: Curculionidae, population, ecology, spatial distribution, habitat environment and density, egg-laying, hatching, larvae, survival ratio, model, *Callosobruchus chinensis*, Bruchidae, Coleoptera, Pterygota, community, group, distribution, density, developmental physiology, larva, growth stage, ratio.

Oloumi-Sadeghi, H.; Levine, E. (1989) **Controlling fungi that colonize eggs of the western corn rootworm in the laboratory.** *Entomologia experimentalis et applicata.* 50(3): 271-279. ISSN: 0013-8703.
NAL Call Number: 421 En895
Descriptors: *Diabrotica virgifera*, *Cylindrocarpon destructans*, laboratory rearing, fungicide, antimicrobial agent, egg, survival, environmental factor, pH, substrate, laboratory study, Chrysomelidae, Coleoptera, *Fungi imperfecti*, fungi, Thallophyta, beetle.

Oloumi-Sadeghi, H.; Levine, E. (1989) **Effect of starvation and time of egg hatch on larval survival of the western corn rootworm, *Diabrotica virgifera virgifera* (Coleoptera: Chrysomelidae), in the laboratory.** *Journal of the Kansas Entomological Society.* 62(1): 108-116. ISSN: 0022-8567.
NAL Call Number: 420 K13
Descriptors: pests, temperature, environmental factors, maize, corn biology, survival, agricultural entomology, *Diabrotica virgifera virgifera*, Chrysomelidae, Coleoptera, *Zea mays*, USA, Illinois, *Cyperales*, Corn Belt States of USA, North Central States of USA, beetle pest, laboratory study.

Sanic, V.; Jankovic-Hladni, M.; Ivanovic, J.; Nenadovic, V. (1989) **Joint effects of temperature, food quality, and season on the development of the cerambycid *Morimus funereus* under laboratory conditions.** *Entomologia Experimentalis et Applicata.* 51(3): 261-267. ISSN: 0013-8703.
NAL Call Number: 421 EN895
Descriptors: diets, temperature, forest pests, biology, environmental impact, trees, agricultural entomology, *Morimus funereus*, Cerambycidae, Coleoptera, *Quercus*, Spermatophyta, plants, forestry, silviculture, laboratory study.

Wright, E.J.; Muller, P. (1989) **Laboratory studies of host finding, acceptance and suitability of the dung-breeding fly, *Haematobia thirouxi potans* (Dipt.: Muscidae), by *Aleochara* sp. (Col.: Staphylinidae).** *Entomophaga.* 34(1): 61-71. ISSN: 0013-8959.
NAL Call Number: 421 En835
Descriptors: host parasite relation, host selection and localization, exploratory behavior, survival, age, parasitism rate, humidity, entomophagous, nuisance, laboratory study, environmental factor, Muscidae, Staphylinidae, dung, host suitability, Diptera, Coleoptera, laboratory study.

1988

Boucher, L.; Pierre, D. (1988) **Études en conditions de laboratoire de la biologie des mariaefranciscae d'Aubeonymus, un parasite de la betterave à sucre. [Mating rythm of *Caryedon serratus* (Coleoptera: Bruchidae) in laboratory and natural conditions.]** *Annales de la Societe Entomologique de France.* 24(2): 151-159. ISSN: 0037-9271. Notes: 6 graphs, 26 ref., In French.
NAL Call Number: 420 F84
Descriptors: *Caryedon*, sexual behavior, copulation, environmental temperature, laboratory experiments, photoperiodicity, Coleoptera, environment, periodicity, physiological functions, reproduction, research, stored products pests, timing, laboratory study, field study.

Branson, T.F.; J.J. Jackson; G.R. Sutter (1988) **Improved method for rearing *Diabrotica virgifera virgifera* (Coleoptera: Chrysomelidae).** *Journal of economic entomology.* 81(1): 410-414. ISSN: 0022-0493.
NAL Call Number: 421 J822
Abstract: The described rearing method approximates the natural environment for larvae of *Diabrotica virgifera virgifera leconte* more closely than do previous methods: eggs are in close proximity to corn roots when they hatch, neonate larvae are not handled, and larvae are reared in soil. In addition, the method is less labor-intensive. Our quality-control samples indicate a mean (+/- SD) return of 53.0% +/- 5.0 from eggs to adults and a mean return of 72.7% +/- 10.2 from neonate larvae to adults. Adult females have a mean head-capsule width of 1.22 mm +/- 0.4. Moreover, our new method for handling adults, both before and during mating, has resulted in a significant improvement in mating: percentage of mated females increased from a mean of 66 to a mean of 95%.
Descriptors: *Diabrotica virgifera*, larvae, containers, rearing techniques and methods, eggs close to corn roots, adult handling.

Daoud, A.S.; Al-Maffti, S.A. (1988) **Biological studies on saw-toothed grain beetle *Oryzaephilus surinamensis* (*l.*) *cucujidae*, Coleoptera in the laboratory under constant temperature conditions.** *Mesopotamia Journal of Agriculture.* 20(2): 325-333. ISSN: 0379-7791.
NAL Call Number: S19.M4
Descriptors: temperature, stored products pests, biology, environmental factors, agricultural entomology, Coleoptera, Silvanidae, *Oryzaephilus surinamensis*, insect pests of plants, biodeterioration organisms, beetle reproduction and development, laboratory study.

Doube, B.M.; Moola, F. (1988) **The effect of the activity of the African dung beetle *Catharsius tricornutus de geer* (Coleoptera: Scarabaeidae) on the survival and size of the African buffalo fly, *Haematobia thirouxi potans* (*bezzi*) (Diptera: Muscidae), in bovine dung in the laboratory.** *Bulletin of Entomological Research.* 78(1): 63-73. ISSN: 0007-4853.
NAL Call Number: 421 B87
Descriptors: ecology, environmental factors, control, behavior, cattle dung, management, *Catharsius tricornutus*, Diptera, Muscidae, Coleoptera, Scarabaeidae, *Haematobia thirouxi potans*, dung beetles, Africa South of Sahara, pest and parasite management, bovine wastes, biological control, public health and nuisance pests, laboratory study.

Malagon, J.; Garrido, A.; Del Busto, T. (1988) **El oviposition de los tenebrionis l. (columna de Capnodis: Buprestidae) obtenidos debajo de laboratorio controlado condiciona árboles frutals. [Oviposition of *Capnodis tenebrionis l.* (Col.: Buprestidae) obtained under controlled laboratory conditions fruit trees.]** *Agronomie* 8(4): 367-371. ISSN: 0249-5627. Notes: 18 ref., In Spanish.
NAL Call Number: SB7.A3
Descriptors: fruit trees, *Capnodis*, oviposition, environmental control, mass rearing in the laboratory, biological techniques, Coleoptera, physiological functions, reproduction.

1987

Ayertey, J.N.; Ibotoye, J.O. (1987) **The growth of laboratory populations of *Sitophilus*, *Rhyzopertha* and *Sitotroga* on sorghum seeds under ambient and humidity-controlled conditions in northern Nigeria.** *Proceedings of the Fourth International Working Conference on Stored Product Protection.* : 435-446. Notes: Tel Aviv, Israel, 21-26 September 1986.
NAL Call Number: SB937 I5 1986
Descriptors: stored products pests, relative humidity, commodities, biology, environmental factors, biodeterioration, agricultural entomology, international working conference, cereal product protection, Gelechiidae, Lepidoptera, Curculionidae, Coleoptera, Bostrichidae, *Sitotroga cerealella*, sorghum, *Sitophilus oryzae*, *Rhyzopertha dominica*, Nigeria, Gramineae, *Cyperales*, West Africa, biodeterioration, storage problems, pests of plants.

Habermann, M.; Schopf, R. (1987) **Untersuchungen über Labordas aufrichten, Hervortreten der jungen Erwachsener und durch Erwachsene von *Scolytus intricatus* (*ratz.*)**

einziehend (Spalte, Scolytidae). [Studies on laboratory rearing, emergence of young adults and feeding by adults of *Scolytus intricatus* (*ratz.*) (Col., Scolytidae).] *Journal of Applied Entomology.* 104(5): 519-528. ISSN: 0931-2048. Note: In German.
NAL Call Number: 421 Z36
Descriptors: development, temperature, environmental factors, biology, trees, agricultural entomology, Coleoptera, *Scolytus intricatus*, *Quercus*, Germany, Western Europe, pests, woody plants, forestry.

Yoshii, T.; Yokoi, N. (1987) **[Rearing of the mulberry small weevil, *Baris deplanata roelofs* by the artificial diet method and the effect of temperature and photoperiod on the larvae.]** *Bulletin of the Fukushima Sericultural Experiment Station.* (22): 36-39. ISSN: 0385-3365. Notes: 8 ref., In Japanese.
Descriptors: *Morus*, *Baris*, mass rearing, photoperiodicity, environmental temperature, compound feeds, leaf eating insects, biological techniques, Coleoptera, environment, environmental conditions, feeds, injurious factors, Moraceae, periodicity, pests, timing, *Urticales*.

1986

Aiken, R.B. (1986) **Diel activity of a boreal water beetle (*Dytiscus alaskanus*: Coleoptera; Dytiscidae) in the laboratory and field.** *Freshwater biology.* 16(2): 155-159. ISSN: 0046-5070.
NAL Call Number: QH96.F6
Descriptors: Coleoptera, beetle activity, behavior, Circadian rhythm, freshwater environment, Alberta, Dytiscidae, Canada, North America, laboratory study, field study.

Stevenson, A.B. (1986) **Relationship between temperature and development of the carrot weevil, *Listronotus oregonensis* (*leconte*) (Coleoptera: Curculionidae) in the laboratory.** *Canadian Entomologist.* 118(12): 1287-1290. ISSN: 0008-347X.
NAL Call Number: 421 C16
Descriptors: carrot weevil biology, environmental temperature factors, techniques, simulation models, root crops, vegetables, agricultural entomology, *Listronotus oregonensis*, *Daucus carota*, Curculionidae, Coleoptera, Umbelliferae, *Apiales*, pests, insect pests of plants, techniques and methodology, laboratory study.

Termier, M. (1986) *L'étude de laboratoire des facteurs influençant le vol de dispersion du decemlineata de Leptinotarsa indiquent [Laboratory study of factors influencing dispersal flight of Leptinotarsa decemlineata Say.]* Univ.: Paris 11, Thesis, 205 p., Availability: CNRS-TD 15328. Note: In French.
Descriptors: flight, dispersion, climate, body weight, host plant, laboratory study, pest, environmental factor, feeding, *Leptinotarsa decemlineata*, Chrysomelidae, Coleoptera.

1985

McCoy, C.; Segretain, C.; Beavers, G.M.; Tarrant, C. (1985) **Laboratory rearing and some aspects of the biology of *Artipus floridanus horn* (Coleoptera: Curculionidae).**

Florida entomologist. 68(3): 379-385. ISSN: 0015-4040.
NAL Call Number: 420 F662
Descriptors: Coleoptera, laboratory rearing, photoperiod, feeding behavior, egg laying behavior, postembryonic development, Curculionidae, pest, laboratory study, environmental factor.

Mohammad, O.S. (1985) **[Biology and efficiency of *Coccinella septempunctata l.* (Coleoptera: Coccinellidae) as a predator of cotton aphid *Aphis gossypii glov.* under laboratory conditions (in Iraq).]** *Zanco.* 3(4): 115-125. Notes: 2 tables; 1 graph; 10 ref., In Arabic.
NAL Call Number: Q1 A1Z3
Abstract: The efficiency of predatism by the four larval instars were 12.7, 31.6, 43.2, 71.8 of aphids and 1037.3 by the adult.
Descriptors: gossypium, *Aphis*, Iraq, predators, biology, aphid developmental stages, temperature, relative humidity, periodicity, atmospheric sciences, crops, developmental stages, dicotyledons, economic plants, environment, environmental conditions, fibre crops, Hemiptera, Homoptera, hydrometeorology, industrial crops, Malvaceae, Malvales, meteorology, Middle East, oil crops, plants, timing.

1984

Ernsting, G.; Huyer, F.A. (1984) **A laboratory study on temperature relations of egg production and development in two related species of carabid beetle.** *Oecologia.* 62(3): 361-367. ISSN: 0029-8549.
NAL Call Number: QL750.O3
Descriptors: Coleoptera, temperature, development, fecundity, body size, environmental factors, laboratory study, Carabidae, *Notiophilus biguttatus*.

White, G.G. (1984) **Variation between field and laboratory populations of *Tribolium castaneum* (*herbst*) (Coleoptera: Tenebrionidae).** *Australian journal of ecology.* 9(2): 153-155. ISSN: 0307-692X.
NAL Call Number: QH540 A8
Descriptors: Coleoptera, development, environment, environmental factor, body weight, larva, Australia, population genetics, Tenebrionidae, study under natural conditions, laboratory study, *Tribolium castaneum*.

1982

Roorda, F.A.; Schulten, G.G.; Andriessen, E.A. (1982) **Laboratory observations on the development of *Tribolium castaneum herbst* (Col. Tenebrionidae) on millet at different temperatures and relative humidities.** *Zeitschrift fur angewandte Entomologie.* 93(5): 446-452. ISSN: 0044-2240.
NAL Call Number: 421 Z36
Descriptors: Coleoptera, stored product, millet, cereal, development, duration, temperature, relative humidity, laboratory study, Tenebrionidae, *Tribolium castaneum*, pest, environmental factor.

Sherrod, D.W.; White, C.E.; Eastman, C.E. (1982) **Temperature-related development of the imported crucifer weevil, *Baris lepidii* (Coleoptera: Curculionidae) in the laboratory and field.** *Environmental entomology.* 11(4): 897-900. ISSN: 0046-225X.
NAL Call Number: QL461 E532
Descriptors: Coleoptera, development, temperature effects, degree day, developmental stage, Curculionidae, Cruciferae, pest, vegetable crop, laboratory study, field study, green house study, environmental factor.

1981

Buckingham, G.R.; Bennett, C.A. (1981) **Laboratory biology and behavior of *Litodactylus leucogaster*, a ceutorhynchine weevil that feeds on watermilfoils.** *Annals of the Entomological Society of America.* 74(5): 451-458. ISSN: 0013-8746.
NAL Call Number: 420 En82
Descriptors: weeds, North America, geographic distribution, development, duration, diagnosis, freshwater, laboratory study, Coleoptera, Curculionidae, fecundity, larva, freshwater environment, nymph, eggs, phytophagous, ecology.

Ives, P.M. (1981) **Coccinellids (Coleoptera) and aphids (Homoptera). Feeding and egg production of two species of Coccinellids in the laboratory.** *The Canadian entomologist.* 113(11): 999-1005. ISSN: 0008-347X.
NAL Call Number: 421 C16
Descriptors: food intake, temperature, laboratory study, pest, entomophagous, Coccinellidae, Coleoptera, environmental factor, fecundity, Homoptera, eggs, predator, predator prey relation, ecology.

Wagner, T.L.; Feldman, R.M.; Gagne, J.A.; Cover, J.D.; Coulson, R.N.; Schoolfield, R.M. (1981) **Factors affecting gallery construction, oviposition, and reemergence of *Dendroctonus frontalis* in the laboratory.** *Annals of the Entomological Society of America.* 74(3): 255-273. ISSN: 0013-8746.
NAL Call Number: 420 En82
Descriptors: laboratory study, construction behavior, models, insect development, Coleoptera, *Dendroctonus frontalis*, population density, limiting factor, environmental factor, gallery construction, egg laying, reproduction, Scolytidae, *Sylvicolous*, body size, temperature, ethology.

1980

Milner, R.J.; Wood, J.T.; Williams, E.R. (1980) **The development of milky disease under laboratory and field temperature regimes.** *Journal of invertebrate pathology.* 36(2): 203-210. ISSN: 0022-2011.
NAL Call Number: 421 J826
Descriptors: *Bacillus popilliae*, bacteria, bacteriosis, Coleoptera, entomopathogen, natural conditions study, laboratory study, evolution, environmental factor, milky disease, Scarabaeidae, temperature effects.

1976

Berry, R.W. (1976) **Laboratory rearing of *Anobium punctatum*.** *Material und Organismen.* 11(3): 171-182. ISSN: 0025-5270.
NAL Call Number: TA401 M32
Descriptors: Anobiidae, growth, biological cycle, rearing, environment, temperature effects, ecology, Coleoptera.

Hosseinie, S.O. (1976) **Comparative life histories of three species of *Tropisternus* in the laboratory (Coleoptera: Hydrophilidae).** *Internationale Revue der gesamten Hydrobiologie.* 61(2): 261-268. ISSN: 1434-2944.
NAL Call Number: QH91 A1I52
Descriptors: biological cycle, Hydrophilidae, freshwater environment, laboratory study.

1975

Clarke, R.G.; Howitt, A.J. (1975) **Development of the strawberry weevil under laboratory and field conditions.** *Annals of the Entomological Society of America.* 68(4): 715-718.
NAL Call Number: 420 En82
Descriptors: pest, post-embryonic development, environment, temperature effects, Coleoptera, laboratory study.

Thiele, H.U. (1975) **Interactions between photoperiodism and temperature with respect to the control of dormancy in the adult stage of *Pterostichus oblongopunctatus f.* (Col., Carabidae). I. Experiments on gonad maturation under different climatic conditions in the laboratory.** *Oecologia.* 19(1): 39-47. ISSN: 0029-8549.
NAL Call Number: QL750 O3
Descriptors: diapause, dormancy, environment, sexual maturity, photoperiod, *Pterostichus*, temperature, reproduction, Coleoptera.

1973

Franek, M. (1973) **Effect of some environmental factors on changes of temperature and habitat conditions inside rearing containers in laboratory cultures of the granary weevil - *Sitophilus granarius l.* (Col., Curculionidae).** *Polskie Pismo Entomologiczne.* 43(1): 189-200. ISSN: 0032-3780. Note: In Polish.
NAL Call Number: 421 P76
Descriptors: biology, techniques, agricultural entomology, laboratory culturing of insects, *Sitophilus granaries*, Curculionidae, Coleoptera, pests, pathogens of plants, methodology, temperature and habitat effects.

1972

Stein, W. (1972) **Der Einfluß der unterschiedlichen Laborhaltung auf Eiablage- und Lebenüberspannung des *Apion virens* Herbstes (Spalte, Curculionidae). [The**

influence of different laboratory attitude on oviposition and life span of *Apion virens autumn* (Col., Curculionidae).] *Zeitschrift fur angewandte Zoologie.* 59(4): 353-360. ISSN: 0044-2291. Note: In German.
NAL Call Number: 449.8 Z36
Descriptors: environment, egg laying, reproduction, laboratory study, survival.

1971

Bell, J.V.; Hamalle, R.J. (1971) **Comparative mortalities between field-collected and laboratory-reared wireworm larvae.** *Journal of Invertebrate Pathology.* 18(1): 150-1. ISSN: 0022-2011.
NAL Call Number: 421 J826
Descriptors: beetles, environment, mitosporic fungi, adaptation, biological insect control, population density, spores, fungal, survivability.

Cavalloro, R.; Girolami, V. (1971) **L'elevazione del decemlineata di Chrysomela dice nel laboratorio e nell'importanza dei fattori ambientali e nutrizionali relativi. [The rearing of *Chrysomela decemlineata say* in the laboratory and the importance of relative environmental and nutritional factors.]** *Redia.* 52: 289-303. ISSN: 0370-4327. Note: In Italian.
NAL Call Number: 421 R241
Descriptors: biology, humidity effects, photoperiod, temperature effects, techniques, insect physiology, *Leptinotarsa decemlineata*, Chrysomelidae, Coleoptera, methodology, physiology and biochemistry, pests of plants.

Collembola

2004

Nilsson, E.; Bengtsson, G. (2004) **Death odour changes movement pattern of a Collembola.** *Oikos.* 104(3): 509-517, ISSN: 0030-1299.
NAL Call Number: 410 OI4
Descriptors: behavior, sensory reception, Acarina, Chelicerata, Collembola, *Hypoaspis aculeifer,* mite, predator, *Protaphorura armata,* food, prey, video-tracking, laboratory techniques, death odor, dispersal behavior, environmental cues, movement patterns, spatial cues, behavioral biology, comparative study.

2002

Bandyopadhyaya, I.; Choudhuri, D.K. (2002) **Laboratory observations on the biology of *Xenylla welchi* (Collembola: Hexapoda).** *Pedobiologia.* 46(3-4): 311-315. ISSN: 0031-4056.
NAL Call Number: 56.8 P343
Descriptors: insect physiology, Collembola, *Xenylla welchi*, laboratory observations, larva, life history, development, egg laying, life span, developmental biology,

embryology, comparative and experimental morphology, pathology.

2001

Salmon, S.; Ponge, J.F. (2001) **Earthworm excreta attract soil springtails: laboratory experiments on *Heteromurus nitidus* (Collembola: Entomobryidae).** *Soil Biology and Biochemistry.* 33(14): 1959-1969. ISSN: 0038-0717.
NAL Call Number: S592.7.A1S6
Descriptors: soil science, terrestrial ecology, Collembola, Oligochaeta, Annelida, *Allolobophora chlorotica*, *Aporrectodea giardi*, *Heteromurus nitidus*, Entomobryidae, springtail, excreta, mucus urine mixture, trophic interaction, environmental biology, soil science, comparative and experimental morphology, physiology.

1993

Vatsauliya, P.K.; Alfred, J.R. (1993) **Laboratory studies on the life history of four species of Collembola from N.E. India.** *Records of the Zoological Survey of India.* 91(2): 203-220. ISSN: 0375-1511.
NAL Call Number: 410.9 IN2R
Descriptors: *Entomobrya kali*, *Salina yosii*, Collembola, egg number, hatching success, life cycle and development, environmental influences, significance for reproductive strategies and population dynamics, abiotic influences and factors, laboratory life history studies, external pH, salinity, temperature, *Seira indica*, *Seira lateralis*, reproductive productivity, ecology, chemical factors, physical factors.

Walsh, M.I.; Bolger, T. (1993) **Effects of diet on the interactions between *Hypogastrura denticulate bagnall* and *Onychiurus furcifer borner* in laboratory cultures.** *European Journal of Soil Biology.* 29(3-4): 155-160. ISSN: 1164-5563.
NAL Call Number: S590 R4
Descriptors: ecology, environmental biology, nutrition, physiology, Collembola, fungi, *Hypogastrura denticulate*, *Onychiurus furcifer*, competition, dietary shift, food preference, population dynamics, predation, behavioral biology, nutrition, nutritional status and methods, comparative and experimental morphology, physiology and pathology, laboratory study.

1991

Leonard, M.A.; Anderson, J.M. (1991) **Growth dynamics of Collembola (*Folsomia candida*) and a fungus (*Mucor plumbeus*) in relation to nitrogen availability in spatially simple and complex laboratory systems.** *Pedobiologia.* 35(3): 163-173. ISSN: 0031-4056.
NAL Call Number: 56.8 P343
Descriptors: *Folsomia candida*, Collembola, diet, fungal feeding ecology, food availability, spatial heterogeneity, relationships, trophic structure, population dynamics, fungal grazing, nutrient availability, spatial environment, heterogeneity, nutrient availability, abiotic factors, physical factors, various laboratory conditions.

1988

Christian, E. (1988) **Induction and detection of moulting synchronization in *Folsomia candida* laboratory populations (Collembola: Isotomidae).** *Revue d'Ecologie et de Biologie du Sol.* 25(4): 469-478. ISSN: 1164-5563.
NAL Call Number: S590 R4
Descriptors: moulting, biological rhythms, environmental impact, physiology, ecdysis, Collembola, *Folsomia candida*, Isotomidae, pests of plants, reproduction and development, environmental economics.

Orthoptera

2004

Chiappero, M.B.; Parise, C.; Marti, D.A.; Bidau, C.J.; Gardenal, C.N. (2004) **Distribution of genetic variability in populations of two chromosomal races of *Dichroplus pratensis* (Melanoplinae, Acrididae) and their hybrid zone.** *Journal of Evolutionary Biology.* 17(1): 76-82. ISSN: 1010-061X.
NAL Call Number: QH359 J68
Descriptors: evolution and adaptation, population genetics, terrestrial ecology, Orthoptera, *Dichroplus pratensis,* acridid grasshopper, chromosomal races, allozyme electrophoresis, laboratory techniques, mating preferences, environmental biology.

Kwon, H.W.; Lent, D.D.; Strausfeld, N.J. (2004) **Spatial learning in the restrained American cockroach *Periplaneta americana*.** *Journal of Experimental Biology.* 207(2): 377-383. ISSN: 0022-0949.
NAL Call Number: 442.8 B77
Descriptors: *Periplaneta americana,* antennae, photoreception, vision, learning, spatial learning abilities, antennal projection response, laboratory study, memory, movements, antennal projection responses, spatial environment, sensory reception, behavior, abiotic factors, physical factors, Blattodea.

Roff, D.; Reale, D. (2004) **The quantitative genetics of fluctuating asymmetry: A comparison of two models.** *Evolution.* 58(1): 47-58. ISSN: 0014-3820.
NAL Call Number: 443.8 Ev62
Descriptors: evolution and adaptation, genetics, computational biology, population genetics, Orthoptera, *Gryllus firmus,* sand cricket, character-state model, environmental responsiveness model, quantitative genetic analysis, laboratory techniques, mathematical and computer techniques, additive genetic variance, diallele cross, directional asymmetry, dominance variance, fluctuating asymmetry, genetic coupling, genotypic correlations, heritability, inbreeding, perfect bilateral symmetry, phenotypic correlations and variance, biocybernetics, comparative study.

Tanaka, S. (2004) **Environmental control of body-color polyphenism in the American grasshopper, *Schistocerca americana*.** *Annals of the Entomological Society of America.* 97(2): 293-301. ISSN: 0013-8746.

NAL Call Number: 420 En82
Descriptors: chemical coordination, homeostasis, population studies, Orthoptera, *Schistocerca Americana,* American grasshopper, body color, polymorphism, rearing density, temperature, ecology, environmental biology, physiology, public health, comparative study, experimental morphology, physiology, pathology.

Worland, M.R.; Wharton, D.A.; Byars, S.G. (2004) **Intracellular freezing and survival in the freeze tolerant alpine cockroach *Celatoblatta quinquemaculata*.** *Journal of Insect Physiology.* 50(2-3): 225-232. ISSN: 0022-1910.
NAL Call Number: 421 J825
Descriptors: chemical coordination, homeostasis, climatology, digestive system, ingestion and assimilation, metabolism, urinary system, Orthoptera, *Celatoblatta quinquemaculata,* alpine cockroach, malpighian tubules, excretory system, fat body cells, midgut, cryomicroscopy, imaging and microscopy techniques, laboratory techniques, altitude, body temperature, cell shrinkage and viability, ice nucleation, intracellular freezing, seasonality, survival, cytology, environmental biology, bioclimatology, biometeorology.

2002

Bertram, S.M. (2002) **The influence of rearing and monitoring environment on temporal mate signaling patterns in the field cricket, *Gryllus texensis*.** *Journal of Insect Behavior.* 15(1): 127-137. ISSN: 0892-7553.
NAL Call Number: QL496.J68
Descriptors: cricket, *Gryllus texensis*, monitoring of rearing environment, calling song, sexual selection, trade off, integer, Orthoptera, Gryllidae, behavior, age, rates, mating behavior.

Gnaspini, P.; Pellegatti, F.F. (2002) **Biology of Brazilian crickets. The cavernicolous *Strinatia brevipennis chopard*, 1970 and the epigean *Endecous itatibensis rehn*, 1918 (Ensifera: Phalangopsidae) in the laboratory I. Feeding, reproduction and egg survival.** *Giornale Italiano di Entomologia* 10(50): 123-132. ISSN: 0392-7296.
NAL Call Number: QL482 I8G56
Descriptors: insect behavior, reproduction, subterranean ecology, environmental biology, Orthoptera, *Endecous itatibensisk*, egg, female, male, *Strinatia brevipennis*, cave cricket, metathoracic gland, spermatophore, reproductive system, terminalia.

2001

Dudek, D.M.; Full, R.J. (2001) **Leg function in running insects: Resilience and impedance of legs linked to a body.** *American Zoologist.* 41(6): 1432-1433. ISSN: 0003-1569. Notes: Conference/Meeting: Annual Meeting of the Society for Integrative and Comparative Biology.
NAL Call Number: 410 Am3
Descriptors: skeletal system, leg movement and support, Orthoptera, *Blaberus discoidalis*, cockroach, body-coxa joint, leg, locomotion, mechanical impedance,

resilience, running, bones, joints, fasciae, connective and adipose tissue, physiology and biochemistry.

1999

Ishii, Y.; Tanaka, I. (1999) **Laboratory observations on the temparature preference of the German cockroach, *Blattella germanica l.*** *Bulletin of Japan Environmental Sanitation Center.* 25: 66-69. ISSN: 0389-0805.
Descriptors: *Blattella germanica*, cockroach behavior, temperature preferences, habitat environment, sensitivity, Blattaria, Pterygota, Orthoptera, laboratory study.

Snyder, W.E.; Tonkyn, D.W.; Kluepfel, D.A. (1999) **Transmission of a genetically engineered rhizobacterium by grasshoppers in the laboratory and field.** *Ecological Applications.* 9(1): 245-253. ISSN: 1051-0761.
NAL Call Number: QH540.E23
Descriptors: corn, field release, genetically engineered plants, grasshopper, insect vector, *Melanoplus femurrubrum*, microcosm, *Pseudomonas aureofaciens*, *Pseudomonas chlororaphis*, rhizobacteria, South Carolina, *Zea mays*, *Pseudomonas fluorescens*, *Erwinia amylovora*, soil microcosms, honey bees, bacteria, organisms, tracking, *Aureofaciens*, environment, rhizosphere, Orthoptera.

1997

De Wysiecki, M.L.; Cigliano, M.M.; Lange, C.E. (1997) **Fecundity and longevity of *Dichroplus elongatus* (Orthoptera: Acrididae) adults under laboratory conditions.** *Revista de la Sociedad Entomologica Argentina.* 56(1-4): 101-104. ISSN: 0373-5680.
NAL Call Number: 420 So14
Descriptors: aging, ecology, genetics, physiology, reproductive system, Orthoptera, *Dichroplus elongates*, Argentina, South America, adult, egg viability, fecundity, gender difference, longevity, oviposition rate, species abundance, zoology, cytogenetics, environmental biology, biochemistry, gerontology, comparative and experimental morphology, physiology and pathology, survivability.

Haes, E.C.M.; P. Harding (1997) *Atlas of grasshoppers, crickets and allied insects in Britain and Ireland.* Institute of Terrestrial Ecology. Ireland. Dept. of Arts, Culture and the Gaeltacht. Joint Nature Conservation Committee (Great Britain). Dept. of the Environment for Northern Ireland. Environment and Heritage Service. London : Stationery Office, 61 p.: maps. ISBN: 0117021172 (pbk.).
NAL Call Number: QL508.A2H34 1997
Descriptors: grasshoppers, crickets, Orthoptera, Great Britain.

1996

Hasegawa, E.; Tanaka, S. (1996) **Sexual maturation in *Locusta migratoria* females: laboratory vs. field conditions.** *Applied entomology and zoology.* 31(2): 279-290. ISSN: 0003-6862.

NAL Call Number: SB599.A6
Descriptors: *Locusta migratoria*, growth, maturation, sex physiology, indoor and outdoor tests, egg-laying, habitat density, density dependence, photoperiodism, habitat, Acridioidea, Orthoptera, Pterygota, biological rhythm.

1995

Demark, J.J.; Bennett, G.W. (1995) **Adult German cockroach (Dictyoptera: Blattellidae) movement patterns and resource consumption in a laboratory arena.** *Journal of Medical Entomology.* 32(3): 241-248. ISSN: 0022-2585.
NAL Call Number: 421 J828
Descriptors: behavior, ecology, environmental biology, economic entomology, physiology, reproductive system, Orthoptera, *Blattella germanica*, computerized image analysis, mating, circadian rhythms and other periodic cycles, laboratory study.

Lactin, D.J.; Johnson, D.L. (1995) **Temperature-dependent feeding rates of *Melanoplus sanguinipes* nymphs (Orthoptera: Acrididae) in laboratory trials.** *Environmental Entomology.* 24(5): 1291-1296. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: ecology, environmental biology, physiology, Homoptera, grasshopper, Orthoptera, *Melanoplus sanguinipes*, mathematical model, temperature as a primary variable, hypothermia, hyperthermia, regulation, thermoadaptation, mathematical biology and statistical methods, biophysics, biocybernetics, laboratory feeding studies.

Olvido, A.E.; T.A. Mousseau (1995) **Effect of rearing environment on calling-song plasticity in the striped ground cricket.** *Evolution.* 49(6): 1271-1277. ISSN: 0014-3820.
NAL Call Number: 443.8 Ev62
Descriptors: Gryllidae, nymphs, developmental stages, songs, temperature, environmental factors, phenotypes, behavior patterns.

1994

Bomar, C.R.; Lockwood, J.A. (1994) **Olfactory basis of cannibalism in grasshoppers (Orthoptera: Acrididae): I. Laboratory assessment of attractants.** *Journal of Chemical Ecology.* 20(9): 2249-2260. ISSN: 0098-0331.
NAL Call Number: QD415.A1J6
Descriptors: development, ecology, environmental biology, genetics, nutrition, pathology, physiology, Orthoptera, *Aulocara elliotti*, *Hadrotettix trifasciatus*, *Melanoplus differentialis*, crowding, developmental stage, necrophagia, necrophilia, sex difference, species specificity, starvation, genetics and cytogenetics, behavioral biology, communication, nutritional status and methods, malnutrition, obesity, developmental biology, embryology, morphogenesis.

Haschemi, H. (1994) **Studien der kalten Toleranz der unterschiedlichen Belastungen von der deutschen Schabe (*Blattella germanica* (*l.*), (Blattodea, Blattidae) unter Labor bedingt. [Studies of the cold tolerance of different strains of the German cockroach**

(*Blattella germanica* (*l.*), (Blattodea, Blattidae) under laboratory conditions.] *Zeitschrift fuer Angewandte Zoologie.* 79(3): 335-348. ISSN: 0044-2291. Note: In German.
NAL Call Number: 449.8 Z36
Descriptors: development, ecology, environmental biology, physiology, Orthoptera, *Blatella germanica*, Germany, adults, habitat, larvae, external effects, cold temperature as a primary variable, temperature measurement, regulation-thermoadaptation, developmental biology, embryology, morphogenesis.

Schmidt, G.H.; Albutz, R. (1994) **Laboratory studies on pheromones and reproduction in the desert locust *Schistocerca gregaria* (*frosk.*).** *Journal of Applied Entomology.* 118(4-5): 378-391. ISSN: 0931-2048.
NAL Call Number: 421 Z36
Descriptors: aging, biochemistry and molecular biophysics, ecology, environmental biology, economic entomology, endocrine system, chemical coordination and homeostasis, physiology, reproductive system, Orthoptera, *Schistocerca gregaria*, adult lifespan, plant pest, temperature gradient, gerontology, comparative and experimental morphology, pathology.

Simmons, L.W.; T. Llorens; M. Schinzig; D. Hosken; M. Craig (1994) **Sperm competition selects for male mate choice and protandry in the bushcricket, *Requena verticalis* (Orthoptera: Tettigoniidae).** *Animal behavior.* 47(1): 117-122. ISSN: 0003-3472.
NAL Call Number: 421 J828
Abstract: Males of the bushcricket, *Requena verticalis*, contribute parental investment at mating via a nutrient-rich spermatophore. Because the first male to mate has a high confidence of paternity, subsequent males have their investment cuckolded. The effects of first male sperm precedence on male mate choice and protandry were investigated. Males were equally likely to mate with virgin and non-virgin females during mating trials. However, they could discriminate on the basis of female age and mated preferentially with young females in laboratory trials and in the field. By using age as a cue, males increase the probability of rejecting non-virgin females, thereby reducing the risks of cuckoldry. It is argued that failure to recognize non-virgins per se may have arisen by sexual conflict over mating, and that the high degree of protandry is an adaptive strategy by males to mate with their preferred young females and enhance their confidence of paternity.
Descriptors: Tettigoniidae, mating behavior, males, laboratory study, virgin females.

1993

Chandra, H.; Singh, R.C. (1993) **Laboratory studies on the biology of surface grasshopper *Chrotogonus oxypterus* (*blanchard*).** *Plant Protection Bulletin (Faridabad).* 45(4): 31-34. ISSN: 0378-0449.
Descriptors: biology, environmental factors, *Chrotogonus oxypterus*, Orthoptera, Acrididae, insect pests of plants, behavior.

Chon, T.S.; Park, Y.S. (1993) **Quantitative observation in the behavior of the smoky brown cockroach, *Periplaneta fuliginosa* (Serville): Presence at important micro-habitats of**

rearing cages in the laboratory. *Korean Journal of Applied Entomology.* 32(3): 354-371. ISSN: 1225-0171.
Descriptors: ecology, muscular system, movement and support, nutrition, physiology, Orthoptera, *Periplaneta fuliginosa*, drinking, feeding, periodicity, principle component analysis, behavioral biology, environmental biology, nutritional status and methods, muscle physiology and biochemistry.

Demark, J.J.; Kuczek, T.; Bennett, G.W. (1993) **Laboratory analysis of the foraging efficiency of nymphal German cockroaches (Dictyoptera: Blattellidae) between resource sites in an experimental arena.** *Annals of the Entomological Society of America.* 86(3): 372-378. ISSN: 0013-8746.
NAL Call Number: 420 En82
Descriptors: biochemistry and molecular biophysics, development, ecology, economic entomology, genetics, nutrition, physiology, Hymenoptera, Orthoptera, *Osmia lignaria propinqua*, *Osmia ribifloris biedermannii*, leaf material, mud, nest plug, parental investment, retrieval and computer applications, genetics and cytogenetics, sex differences, behavioral biology, environmental biology, physiological water studies, movement, nutritional status and methods, developmental biology, embryology.

Khrustaleva, N.A. (1993) **Study of the motility and distributional capacity of synanthropic cockroaches obtained from the natural biotopes and kept together in laboratory conditions.** *Zoologicheskii Zhurnal.* 72(10): 36-40. ISSN: 0044-5134.
NAL Call Number: 410 R92
Descriptors: ecology, environmental biology, economic entomology, Orthoptera, *Blattella germanica*, *Supella longipalpa*, dispersal, females, males, territory, general and comparative behavior, sanitary entomology, genetics and cytogenetics, sex differences.

Roff, D.A.; Shannon, P. (1993) **Genetic and ontogenic variation in behavior - its possible role in the maintenance of genetic-variation in the wing dimorphism of *Gryllus firmus*.** *Heredity.* 71: 481-487. ISSN: 0018-067X.
NAL Call Number: 443.8 H42
Descriptors: behavior, genetic variation, *Gryllus firmus*, thermal preference, wing dimorphism, environmental sex determination, sand cricket, heritability, *Drosophila*, selection, evolution, fitness, ratio, Orthoptera.

1992

Pires, A.; Hoy, R.R. (1992) **Temperature coupling in cricket acoustic communication. I : Field and laboratory studies of temperature effects on calling song production and recognition in *Gryllus firmus*.** *Journal of comparative physiology. A, Sensory, neural, and behavioral physiology.* 171(1): 69-78. ISSN: 0340-7594.
NAL Call Number: QP33 J68
Descriptors: temperature, song, phonotactism, environmental factor, sound recognition, sound production, acoustic communication, cricket communication, Gryllidae, Orthoptera.

1991

Elder, R.J. (1991) **Laboratory studies of environmental-factors affecting sexual-maturation in *Nomadacris-guttulosa* (*walker*) (Orthoptera, Acrididae).** *Journal of the Australian Entomological society.* 30: 169-181.
NAL Call Number: 420 EN823
Descriptors: cold hardiness, larval diapause, nucleator activity, overwintering survival, low-temperature tolerance, metabolic responses, changing photoperiods, sexual development.

1989

Ackonor, J.B. (1989**) Laboratory studies on the effects of flood on egg development, survival and hatchling weight in *Locusta migratoria migratorioides* (*reiche* and *fairmaire*).** *Insect Science and its Application.* 10(4): 485-490. ISSN: 0191-9040.
NAL Call Number: QL461.I57
Descriptors: pests, flooding, environmental factors, agricultural entomology, Orthoptera, Acrididae, *Locusta migratoria*, insect pests of plants.

Ackonor, J.B. (1989**) Laboratory studies on the impact of drought on egg development, survival and hatchling weight in *Locusta migratoria migratorioides* (*reiche and fairmaire*).** *Insect Science and its Application.* 10(5): 639-643. ISSN: 0191-9040.
NAL Call Number: QL461.I57
Descriptors: pests, development, survival, egg hatchability, drought, weight, environmental factors, agricultural entomology, locusts, Acrididae, Orthoptera, insect pests of plants.

Elder, R.J. (1989**) Laboratory studies on the life history of *Nomadacris guttulosa* (*walker*) (Orthoptera: Acrididae).** *Journal of the Australian Entomological Society.* 28(4): 247-253. ISSN: 0004-9050.
NAL Call Number: 420 En823
Descriptors: development, temperature, environmental factors, biology, food plants, wheat, agricultural entomology, *Nomadacris guttulosa*, Orthoptera, Acrididae, locusts, *Triticum*, Gramineae, *Cyperales*, insect pests of plants.

Hudson, W.G.; Nguyen, K.B. (1989) **Effects of soil moisture, exposure time, nematode age, and nematode density on laboratory infection of *Scapteriscus vicinus* and *S. acletus* (Orthoptera: Gryllotalpidae) by *Neoaplectana* sp. (Rhabditida: Steinernematidae).** *Environmental Entomology.* 18(4): 719-722. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: pests, natural enemies, environmental factors, entomophilic nematodes, pathogens, hosts, pathogenicity, entomopathogens, nematology, Orthoptera, Gryllotalpidae, Nematoda, *Scapteriscus vicinus*, *Scapteriscus acletus*, *Neoaplectana*, Uruguay, Steinernematidae, South America, biological control, parasites, vectors, pathogens of insects and plants.

1985

Loher, W.; Orsak, L.J. (1985) **Circadian patterns of premating behavior in *Teleogryllus oceanicus le guillou* under laboratory and field conditions.** *Behavioral Ecology and Sociobiology.* 16(3): 223-231. ISSN: 0340-5443.
URL: http://link.springer.de/link/service/journals/00265/index.htm
NAL Call Number: QL751.B4
Descriptors: circadian rhythms, courtship behavior, environments, laboratory vs. field conditions, circadian patterns of male and female premating behavior, crickets, social and instinctive behavior, Orthoptera.

1983

Barson, G.; Renn, N. (1983) **Hatching from Oothecae of the German Cockroach (*Blatella germanica*) under laboratory culture conditions and after premature removal.** *Entomologia experimentalis et applicata.* 34(2): 179-185. ISSN: 0013-8703.
NAL Call Number: 421 En895
Descriptors: Dictyoptera, laboratory study, hatching, insecticide, temperature, humidity, *Blattella germanica*, nuisance, environmental factors, urethane.

1981

Schmidt, G.H. (1981) **Growth and behavior of *Acrotylus patruelis* (*h.-s.*) larvae in temperature gradients under laboratory conditions.** *Zoologischer Anzeiger.* 206(1-2): 11-25. ISSN: 0323-3774.
NAL Call Number: 410 Z7
Descriptors: Acrididae, behavior, growth, postembryonic development, laboratory study, environmental factor, Orthoptera, temperature.

Hemiptera

2002

Bressa, M.J.; Fumagalli, E.; Ituarte, S.; Frassa, M.V.; Larramendy, M.L. (2002) **Meiotic studies in *Dysdercus guerin meneville*, 1831 (Heteroptera: Pyrrhocoridae). II. Evidence on variations of the diffuse stage between wild and laboratory-inbred populations of *Dysdercus chaquensis freiberg*, 1948.** *Hereditas.* 137(2): 125-131. ISSN: 0018-0661.
NAL Call Number: 442.8 H42
Descriptors: meiosis, breed difference, genetics, development, cytology, chromosome structure and number, developmental stage, wild species, cell growth, transcription initiation, environmental factor, physiology, microbiology, bacteriology, mycology, parasitology, virology, Hemiptera.

Filippi, L.; Hironaka, M.; Nomakuchi, S. (2002) **Risk-sensitive decisions during nesting may increase maternal provisioning capacity in the subsocial shield bug *Parastrachia***

japonensis. *Ecological Entomology*. 27(2): 152-162. ISSN: 0307-6946.
NAL Call Number: QL461.E4
Descriptors: Cydnidae, environmental constraints, female decisions, intraspecific competition, parental care, provisioning, resource constraints, risk-sensitive behavior, foraging behavior, predation risk, Hemiptera, environment, allocation, parasitism, beetle.

Torres-Estrada, J.L.; Martinez-Ibarra, J.A.; Garcia-Perez, J.A. (2002) **Selection of resting sites of *Triatoma gerstaeckeri* (*stal*) (Hemiptera: Reduviidae) females under laboratory and field conditions.** *Folia Entomologica Mexicana*. 41(1): 63-66. ISSN: 0430-8603.
NAL Call Number: 421 F712
Descriptors: behavior, terrestrial ecology, environmental biology, vector biology, Heteroptera, *Triatoma gerstaeckeri*, disease vector, Chagas disease, parasitic disease, transmission.

2000

Rocha, D.S.; Jurberg, J.; Carcavallo, R.U.; Cunha, V.; Galvao, C. (2000) **Influence of temperature and humidity on the development of *Rhodnius robustus larrousse*, 1927 under laboratory conditions (Hemiptera, Reduviidae, Triatominae).** *Memorias do Instituto Oswaldo Cruz*. 95(2): 334. ISSN: 0074-0276. Notes: XXVII Annual Meeting on Basic Research in Chagas Disease and the XVI Annual Meeting of Brazilian Society of Protozoology Caxambu, Brazil, November 06-08, 2000.
NAL Call Number: 448.9 IN74
Descriptors: development, ecology, Heteroptera, *Rhodnius robustus*, Chagas disease, parasitic disease, WHO, embryonic periods, global warming, humidity, postembryonic period, temperature, environmental biology.

Ruberson, J.R.; Y.J. Shen; T.J. Kring (2000) **Photoperiodic sensitivity and diapause in the predator *Orius insidiosus* (Heteroptera: Anthocoridae).** *Annals of the Entomological Society of America*. 93(5): 1123-1130. ISSN: 0013-8746.
NAL Call Number: 420 En82
Abstract: Ontogenetic timing of photoperiodic sensitivity is critical in the life history of insects that rely on photoperiod as a token stimulus. The life stages of *Orius insidiosus* (Say) sensitive to photoperiod for diapause induction were investigated by transferring predators between short (10:14 [L:D] h) and long (14:10[L:D]h) constant photoperiods (at 20 degrees C) at various life stages. Bugs were considered to be in diapause if their preoviposition period exceeded 14 d after adult eclosion. The first three instars exhibited no clear sensitivity to photoperiod relative to diapause induction or intensity (as measured by preoviposition period). The fourth instar was somewhat sensitive, appearing to enhance the sensitivity of subsequent stages. In contrast, the fifth instar was highly sensitive to the short photoperiod. Exposure of bugs to short photoperiods during this instar induced diapause in at least 50% of the population. Likewise, the adult stage was sensitive to photoperiod during at least the first 14 d after eclosion. Exposure to short photoperiods during the early adult stage also appears to be necessary to induce diapause in approximately 50% of the population. In addition, short photoperiod served to maintain diapause in adult females. Transferring diapausing adults from short to long photoperiods accelerated diapause termination relative to those remaining in short

photoperiod.
Descriptors: *Orius insidiosus*, predatory insects, diapause, oviposition, photoperiod sensitivity, age differences, developmental stages, instars, laboratory study.

1999

Martinez-Ibarra, J.A.; Katthain-Duchateau, G. (1999) **Biology of *Triatoma pallidipennis stal* 1945 (Hemiptera: Reduviidae:Triatominae) under laboratory conditions.** *Memorias do Instituto Oswaldo Cruz.* 94(6): 837-839. ISSN: 0074-0276.
NAL Call Number: 448.9 IN74
Descriptors: ecology, Heteroptera, *Triatoma pallidipennis*, adult, egg, female, nymph, bloodmeal number, ethology, hatching rate, laboratory conditions, life-cycle, mortality rate, survival, general and systematic zoology, environmental biology, nutrition general studies, nutritional status and methods, comparative and experimental morphology, physiology and pathology, reproductive system, developmental biology, embryology, laboratory study.

Rocha, D.S.; Galvao, C.; Jurberg, J.; Cunha, V.; Carcavallo, R.U. (1999) **The influence of temperature and humidity on the life cycle of *Rhodnius neglectus lent*, 1954 in laboratory (Hemiptera, Reduviidae, Triatominae).** *Memorias do Instituto Oswaldo Cruz.* 94(2): 242. ISSN: 0074-0276. Notes: XXVI Annual Meeting on Basic Research in Chagas' Disease and the XV Annual Meeting of Brazilian Society of Protozoology. Caxambu, Brazil, November 09-11, 1999.
NAL Call Number: 448.9 IN74
Descriptors: development, climatology, Heteroptera, *Rhodnius neglectus*, Chagas' disease, bloodmeal, egg development, global warming, humidity, life cycle, oviposition, temperature, comparative and experimental morphology and physiology, environmental biology, external effects, reproductive system.

1998

Braga, M.V.; Pinto, Z.T.; Lima, M.M. (1998) **Life cycle and reproductive patterns of *Triatoma rubrofasciata* (*de geer*, 1773) (Hemiptera: Reduviidae), under laboratory conditions.** *Memorias do Instituto Oswaldo Cruz.* 93(4): 539-542. ISSN: 0074-0276.
NAL Call Number: 448.9 IN74
Descriptors: temperature, feeding, life cycle, lifespan, rearing techniques, laboratory insects, biological development, reproduction, fertility, longevity, environmental factors, *Triatoma rubrofasciata*, mice, Reduviidae, Heteroptera, Hemiptera, parasites, vectors, pathogens and biogenic diseases of humans and insects.

Watson, P.J.; Arnqvist, G.; Stallmann, R.R. (1998) **Sexual conflict and the energetic costs of mating and mate choice in water striders.** *American Naturalist.* 151(1): 46-58. ISSN: 0003-0147.
NAL Call Number: 470 Am36
Descriptors: metabolism, Heteroptera, *Aquarius remigis*, energetic costs, locomotion, mate choice, mate-carrying, sexual conflict, behavioral biology, ecology, environmental

biology, metabolic pathways, reproductive system, comparative and experimental morphology and physiology.

1997

Mendonca, F.A.; Barreto, M.R.; Assis, S. Jr; Marsaro, A.L. Jr. (1997) **Courtship and copulation behavior of the predator *Supputius cincticeps* (*stal*) (Heteroptera: Pentatomidae) in laboratory.** *Anais da Sociedade Entomologica do Brasil.* 26(1): 209-212. ISSN: 0301-8059.
NAL Call Number: QL461.S64
Descriptors: ecology, physiology, reproductive system, Heteroptera, *Supputius cincticeps*, copulation, courtship, predator, behavioral biology, environmental biology, comparative and experimental morphology and physiology.

1995

Islam, K.S.; Copland, M.J.; Jahan, M. (1995) **Laboratory studies on the development of *Planococcus citri* (*risso*) and *Pseudococcus affinis* (*mask.*) at different temperatures.** *Bangladesh Journal of Entomology.* 5(1/2): 19-24. ISSN: 1021-1004.
Descriptors: temperature effects, biology, development, environmental factors, agricultural entomology, *Planococcus citri*, *Pseudococcus*, Coccoidea, Sternorrhyncha, Homoptera, Hemiptera, pathogens and biogenic diseases of plants, insect behavior.

Nakata, T. (1995) **Effect of rearing temperature on the development of *Orius sauteri* (*poppius*) (Heteroptera: Anthocoridae).** *Applied Entomology and Zoology* 30(1): 145-151. ISSN: 0003-6862. Notes: 3 tables; 3 fig.; 10 ref.
NAL Call Number: SB599 A6
Descriptors: *Orius*, predators, laboratory rearing techniques, biological development, environmental temperature effects, Anthocoridae, environmental factors, Hemiptera, Heteroptera, natural enemies.

Wood, D.L.; McPherson, J.E. (1995) **Life history and laboratory rearing of *Hydrometra hungerfordi torre-bueno* (Heteroptera: Hydrometridae) with descriptions of immature stages.** *Proceedings of the Entomological Society of Washington.* 97(3): 717-728. ISSN: 0013-8797.
NAL Call Number: 420 W27
Descriptors: climatology, development, ecology, nutrition, Heteroptera, *Hydrometra hungerfordi*, adult, ecology, nymph, seasonality, environmental biology, bioclimatology and biometeorology, developmental biology, embryology, morphogenesis.

1994

Brown, L.N.; McPherson, J.E. (1994) **Life history and laboratory rearing of *Gelastocoris oculatus oculatus* (*fabricius*) (Hemiptera: Gelastocoridae) with descriptions of immature stages.** *Proceedings of the Entomological Society of Washington.* 96(3): 516-526. ISSN: 0013-8797.

NAL Call Number: 420 W27
Descriptors: development, ecology, morphology, Chlorophyta, Heteroptera, *Cladophora* sp., *Gelastocoris oculatus oculatus*, *Rhizoclonium* sp., fresh water, nymphs, overwintering, environmental biology, developmental biology, embryology, morphogenesis, zoology, Hemiptera, comparative and experimental morphology, physiology, circadian rhythms and other periodic cycles, environmental biology, bioclimatology and biometeorology, limnology, external effects, temperature effects, thermorhythms.

James, D.G.; C.J. Moore; J.R. Aldrich (1994) **Identification, synthesis, and bioactivity of a male-produced aggregation pheromone in assassin bug, *Pristhesancus plagipennis* (Hemiptera: Reduviidae).** *Journal of chemical ecology.* 20(12): 3281-3295. ISSN: 0098-0331.
NAL Call Number: QD415.A1J6
Abstract: *Pristhesancus plagipennis*, a large Australian assassin bug, possesses three pairs of dorsal abdominal glands (DAGs). In the male, the anterior and posterior glands are hypertrophied and secrete an attractant pheromone. Gas chromatography-mass spectrometry (GC-MS) analyses of male DAG extracts and airborne volatiles emitted from calling males showed the pheromone signature to be dominated by a novel component. Subsequent chemical manipulations, GC-MS, and chiral-column analyses established its identity as (Z)-3-hexenyl (R)-2-hydroxy-3-methylbutyrate. Minor components included 3-methylbutanol, 2-phenylethanol, (Z)-3-hexenol, decanal, (E)-2-hexenoic acid, and three minor hexenyl esters. Bioactivity studies using laboratory olfactometers and outdoor flight cages demonstrated attraction by female *P. plagipennis* to calling males, heptane extracts of male posterior DAGs and a synthetic formulation of the (Z)R enantiomer of the major ester, alone or in combination with other components of male anterior and posterior DAGs. Males were also attracted to the major ester. The racemate and S enantiomer of the ester were not attractive. Contamination of the (Z)R enantiomer with 30-60% of the E isomer also made the compound nonattractive. This is the first report of an aggregation pheromone in the Reduviidae. The prospects for pheromonal manipulation of *P. plagipennis* populations to enhance the value of this predator in horticultural ecosystems, are discussed.
Descriptors: Reduviidae, males, aggregation pheromones, insect glands, extracts, chemical composition, biological control agents, chemical analyses, gas chromatography.

Munyaneza, J.; McPherson, J.E. (1994) **Comparative study of life histories, laboratory rearing, and immature stages of *Euschistus servus* and *Euschistus variolarius* (Hemiptera: Pentatomidae).** *Great Lakes Entomologist.* 26(4): 263-274. ISSN: 0090-0222.
NAL Call Number: QL461 M5
Descriptors: climatology, development, ecology, morphology, physiology, reproductive system, Hemiptera, Heteroptera, Leguminosae, *Euschistus servus*, *Euschistus variolarius*, Hemiptera, *Phaseolus vulgaris*, *Verbascum thapsus*, Illinois, USA, egg morphology, life stage, seasonality, environmental biology, bioclimatology and biometeorology, anatomy and histology, developmental biology, embryology, morphogenesis.

Rojas, J.C.; Cruz-Lopez, L. (1994) **Factors affecting the response of *Triatoma mazzottii* to the**

aggregation pheromone in the laboratory. *Southwestern Entomologist.* 19(4): 393-401. ISSN: 0147-1724.
NAL Call Number: QL461 S65
Descriptors: attractants, environmental factors, temperature, pheromones, aggregation pheromones, behavior, *Triatoma mazzottii*, Heteroptera, Reduviidae, Triatominae, Hemiptera, parasites, vectors, pathogens and biogenic diseases of humans, repellents and attractants.

1993

Torres-Estrada, J.L.; Martinez-Ibarra, J.A.; Garcia-Perez, J.A. (1993) **Sitios de reclinación de interior de las quinto-instar ninfas de las condiciones inferiores stal del laboratorio y del campo del gerstaeckeri de *Triatoma*. [Indoor resting sites of fifth-instar nymphs of *Triatoma gerstaeckeri stal* under laboratory and field conditions.]** *Southwestern Entomologist.* 18(1): 45-49. ISSN: 0147-1724. Note: In Spanish.
NAL Call Number: QL461.S65
Descriptors: development, ecology, nutrition, physiology, Heteroptera, Hymenoptera, *Anoplolepis custodiens*, *Camponotus vagus*, *Formica polyctena*, *Lasius niger*, *Polyrhachis gagates*, morphology, worker ant, behavioral biology, environmental biology, nutritional status and methods, developmental biology, embryology, morphogenesis, comparative and experimental morphology, pathology, soil science, genesis, morphology, classification.

1992

Cohen, A.C.; Byrne, D.N. (1992) ***Geocoris punctipes* as a predator of *Bemisia tabaci*: A laboratory evaluation.** *Entomologia Experimentalis et Applicata.* 64(2): 195-202. ISSN: 0013-8703.
NAL Call Number: 421 EN895
Descriptors: digestive system, ingestion and assimilation, ecology, economic entomology, metabolism, nutrition, pest assessment control and management, physiology, Convolvulaceae, Hemiptera, Heteroptera, Homoptera, aphids, *Bemisia tabaci*, *Geocoris punctipes*, biological control, carbohydrates, energy budget, lipids, nutrition, prey consumption, protein, saliva, environmental biology, metabolism-energy and respiratory, biochemistry, comparative and experimental morphology, pathology, behavioral biology, blood, blood-forming organs and body fluids, biophysics.

Kight, S.L.; Kruse, K.C. (1992) **Factors affecting the allocation of paternal care in waterbugs (*Belostoma flumineum say*).** *Behavioral Ecology and Sociobiology.* 30(6): 409-414.
NAL Call Number: QL751.B4
Descriptors: investment decision rules, *Parus major* parents, nest defense, reproductive effort, concorde fallacy, environments, Heteroptera, desertion, selection, evolution.

Vecchio, M.C.; Grazia, J. (1992) **Obtainment de massas do ovo do ypsilongriseus de *Oebalus* (*de geer, 1773*) no laboratório (Heteroptera: Pentatomidae). [Obtainment of egg masses of *Oebalus ypsilongriseus* (*de geer, 1773*) in laboratory (Heteroptera:**

Pentatomidae).] *Anais da Sociedade Entomologica do Brasil.* 21(3): 367-373. ISSN: 0301-8059. Note: In Portuguese.
NAL Call Number: QL461.S64
Descriptors: biosynchronization, ecology, economic entomology, physiology, reproductive system, Coleoptera, Heteroptera, Leguminosae, *Chalcodermus bimaculatus*, *Vigna unguiculata*, cultivar, environmental biology, biochemistry, temperature: measurement, effects and regulation, thermorhythms.

1989

Crowl, T.A.; Alexander, J.E. Jr. (1989) **Parental care and foraging ability in male water bugs (*Belostoma flumineum*).** *Canadian journal of zoology.* 67(2): 513-515. ISSN: 0008-4301.
NAL Call Number: 470 C16D
Descriptors: Hemiptera, foraging, parental role, males, aquatic environment.

Gorla, D.E. (1989) **Influence of photoperiod on *Triatoma infestans* (*klug*), *1834* under laboratory conditions.** *Revista de la Sociedad Entomologica Argentina.* 45(1-4): 175-179.
NAL Call Number: 420 So14
Descriptors: reproduction, photoperiod, environmental factors, development, Hemiptera, Reduviidae, *Triatoma infestans*, Heteroptera, parasites, vectors, pathogens and biogenic diseases of humans, behavior.

1988

Nagem, R.L.; Ramiro-Botelho, J.; Da Silva-Negromonte, M.R. (1988) **Bionomy of *Cimex lectularius l., 1758* (Hemiptera, Cimicidae) in Belo Horizonte. I: observations on oviposition and egg incubation period in laboratory.** *Revista brasileira de Entomologia.* 32(2): 323-329. ISSN: 0085-5626.
NAL Call Number: 421 R3292
Descriptors: laboratory study, fecundity, incubation, duration, temperature, humidity, environmental factors, vector, *Cimex lectularius*, Heteroptera.

1987

Fauvel, G.; Malausa, J.C.; Kaspar, B. (1987) **Laboratory studies on the main biological characteristics of *Macrolophus caliginosus* (Heteroptera: Miridae).** *Entomophaga.* 32(5): 529-543. ISSN: 0013-8959. Notes: 5 tables, 7 graphs, 12 ref., In French.
NAL Call Number: 421 En835
Descriptors: Heteroptera, biological control, life cycle, environmental temperature effects, biological rhythms, environment, Hemiptera, timing.

Karsvuran, Y.; Onder, F. (1987) **Some investigations on the survival curves for the rearing of *Dolycoris baccarum* (*l.*) (Het.: Pentatomidae) on different combinations of water and food in laboratory conditions.** *Turkiye Entomoloji Dergisi.* 11(3): 185-189. Note: In

Turkish.
Descriptors: temperature, photoperiod, relative humidity, environmental factors, stored products, stimulant plants, techniques, agricultural entomology, tobacco, Hemiptera, development, Pentatomidae, *Dolycoris baccarum*, *Nicotiana*, Spermatophyta, Heteroptera, Solanaceae, pests, pathogens and biogenic diseases of plants, techniques and methodology.

1986

Aldrich, J.R. (1986) **Seasonal variation of black pigmentation under the wings in a true bug (Hemiptera: Pentatomidae): a laboratory and field study.** *Proceedings of the Entomological Society of Washington.* 88(3): 409-421. ISSN: 0013-8797.
NAL Call Number: 420 W27
Descriptors: Heteroptera, predator, color, abdomen, melanism, cuticle, environmental factor, hormonal regulation, *Podisus maculiventris*, Pentatomidae, seasonal effects.

Amaral Filho, B.F. do (1986) **Efeito de dietas naturais e de fatores ambientais na biologia do picta de *Phthia* (*drury, 1770*) (Hemiptera, Coreidae) sob o laboratório condiciona. [Effect of natural diets and environmental factors on the biology of *Phthia picta* (*drury, 1770*) (Hemiptera, Coreidae) under laboratory conditions.]** *Boletim da Sociedade Portuguesa de Entomologia.* II-8(38): 97-98. ISSN: 0871-0554. Note: In Portuguese.
NAL Call Number: QL482.P8B85
Descriptors: vegetables, tomatoes, pumpkins, environmental factors, agricultural entomology, *Phthia picta*, *Lycopersicon esculentum*, Cucurbita, Brazil, Sao Paulo, Solanaceae, plants, Violales, Brazil, pests of plants.

Lima, M.M.; Jurberg, P.; Almeida, J.R. de (1986) **Behavior of triatomines (Hemiptera: Reduviidae) vectors of Chagas' disease. II. Influence of feeding, lighting and time of day on the number of matings, mating speed and duration of copulation of *Panstrongylus megistus* (*burm, 1835*) under laboratory conditions.** *Memorias do Instituto Oswaldo Cruz.* 81(4): 381-388. ISSN: 0074-0276.
NAL Call Number: 448.9 IN74
Descriptors: environmental factors, reproduction, mating behavior, Triatominae, *Panstrongylus megistus*, Reduviidae, Hemiptera, Heteroptera, parasites, insect vectors.

McPherson, J.E.; Packauskas, R.J. (1986) **Life history and laboratory rearing of *Belostoma lutarium* (Heteroptera: Belostomatidae) with descriptions of immature stages.** *Journal of the New York entomological Society.* 94(2): 154-162. ISSN: 0028-7199.
NAL Call Number: 420 N48J
Descriptors: Heteroptera, postembryonic development, morphology, measurement, life history, Belostomatidae, aquatic environment, rearing, laboratory study.

Packauskas, R.J.; Mcpherson, J.E. (1986) **Life history and laboratory rearing of *Ranatra fusca* (Hemiptera: Nepidae) with descriptions of immature stages.** *Annals of the Entomological Society of America.* 79(4): 566-571. ISSN: 0013-8746.
NAL Call Number: 420 En82

Descriptors: Heteroptera, life history, postembryonic development, rearing, Nepidae, freshwater environment, predator.

Venkataraman, K.; Krishnaswamy, S. (1986) ***Anisops bouvieri* predation and advantages of cephalic expansion in *Daphnia cephalata king* and the impact of predation on *Daphnia similis claus* under laboratory conditions.** *Proceedings of the Indian Academy of Sciences. Animal sciences.* 95(5): 509-513. ISSN: 0253-4118.
NAL Call Number: QL1 I48
Descriptors: Heteroptera, Hemiptera, predator, Branchiopoda, defense, morphology, head, predator prey relation, India, freshwater environment, tropical zone, Cladocera, Notonectidae, Asia.

1985

Kittle, P.D. (1985) **The laboratory life history of *Trepobates knighti* (Hemiptera: Gerridae).** *Journal of the Kansas Entomological Society.* 58(2): 348-352. ISSN: 0022-8567.
NAL Call Number: 420 K13
Descriptors: Heteroptera, life history, laboratory study, leg, antenna, morphology, measurement, freshwater, environment, Gerridae.

Santamarina, M.A.; Gonzalez, B.R. (1985) **La capacidad rapaz de Hemiptera acuático debajo del laboratorio condiciona. [Predatory capacity of aquatic Hemiptera under laboratory conditions.]** *Revista cubana de medicina tropical.* 37(2): 203-9. ISSN: 0375-0760. Note: In Spanish.
Descriptors: appetitive behavior, physiology, Hemiptera physiology, predatory behavior and physiology, environment, control, methods.

1984

Jurberg, J.; Rangel, E.F. (1984) **Ciclo biológico do barbeiro dos pallescens de *Rhodnius*, 1932 no laboratório (Hemiptera, Reduviidae, Triatominae). [Biological cycle of *Rhodnius pallescens barber, 1932* in laboratory (Hemiptera, Reduviidae, Triatominae).]** *Memorias do Instituto Oswaldo Cruz.* 79(3): 303-308. ISSN: 0074-0276. Note: In Portuguese.
NAL Call Number: 448.9 IN74
Descriptors: Heteroptera, development, duration, laboratory study, diet, humidity, temperature, light, Reduviidae, environmental factors.

1983

Halverson, T. (1983) **Temperature dependent embryogenesis in *Aeshna tuberculifera walker* and *Plathemis lydia* (*drury*) under field and laboratory conditions (Anisoptera: Aeshnidae, Libellulidae).** *Odonatologica.* 12(4): 367-373. ISSN: 0375-0183.
NAL Call Number: QL520.A38
Descriptors: *Aeshna tuberculifera*, Odonata, hatching success, temperature and environmental oxygen effects, ontogenesis, embryogenesis, gases, effect on hatching and

development, *Aeshna tubulifera*, *Plathemis Lydia*, reproduction, life cycle, abiotic factors, chemical factors, physical factors, land and freshwater zones, Hemiptera, Virginia, USA.

Wheeler, A.G. Jr; Miller, G.L. (1983) ***Harmostes fraterculus* (Hemiptera: Rhopalidae): field history, laboratory rearing, and descriptions of immature stages.** *Proceedings of the Entomological Society of Washington.* 85(3): 426-434. ISSN: 0013-8797.
NAL Call Number: 420 W27
Descriptors: Heteroptera, life history, season, Pennsylvania, USA, Rhopalidae, environmental factor, developmental stages.

1981

Amaral Filho, B.F. do (1981) **O efeito de dietas naturais e de fatores ambientais na biologia do picta de *Phthia* (*drury, 1770*) sob o laboratório condiciona (Hemiptera, Coreidae). [Effect of natural diets and environmental factors on the biology of *Phthia picta* (*drury, 1770*) under laboratory conditions (Hemiptera, Coreidae).]** *Revista Brasileira de Biologia.* 41(4): 845-853. ISSN: 0034-7108. Note: In Portuguese.
NAL Call Number: 442.8 R326
Descriptors: biology, tomatoes, pumpkins, development, squashes, vegetables, agricultural entomology, *Phthia picta*, Solanaceae, *Lycopersicon esculentum*, *Cucurbita*, plants, Violales, pests of plants.

Cheng, L. (1981) ***Halobates* (Heteroptera: Gerridae) from Micronesia with notes on a laboratory population of *H. mariannarum*.** *Micronesia.* 17(1-2): 97-106. ISSN: 0026-279X.
NAL Call Number: 475 M58
Descriptors: taxonomy, diagnosis, North Pacific, Gerridae, marine environment, Heteroptera.

Isenhour, D.J.; Yeargan, K.V. (1981) **Effect of temperature on the development of *Orius insidiosus* with notes on laboratory rearing.** *Annals of the Entomological Society of America.* 74(1): 114-116. ISSN: 0013-8746.
NAL Call Number: 420 En82
Descriptors: temperature effects, development, laboratory rearing, entomophagous, Anthocoridae, environmental factor, Heteroptera, *Orius insidiosus*, predator.

Kittle, P.D.; Mccraw, J.T. (1981) **The laboratory life history of *Trepobates subnitidus* (Hemiptera: Gerridae).** *Journal of the Kansas Entomological Society.* 54(1): 8-15. ISSN: 0022-8567.
NAL Call Number: 420 \b K13
Descriptors: embryonic development, postembryonic development, diagnosis, laboratory study, Gerridae, Heteroptera, measurement, freshwater environment, body size, life history.

1980

Vasconcellos, H. de O.; Cruz, C. de A.; Oliveira, A.M. de (1980) **Evaluation of the reproductive capacity of *Orthezia praelonga douglas, 1891*, in the laboratory and insectary environment.** *Anais da Sociedade Entomologica do Brasil.* 9(2): 189-197. ISSN: 0301-8059.
NAL Call Number: QL461.S64
Descriptors: Hemiptera, reproduction, oranges, fruit crops, agricultural entomology, *Orthezia praelonga*, *Citrus*, *Acalypha*, Brazil, Rutaceae, Sapindales, Euphorbiaceae, South America, pests of plants.

1977

Khattat, A.R.; Stewart, R.K. (1977) **Development and survival of *Lygus lineolaris* exposed to different laboratory rearing conditions.** *Annals of the Entomological Society of America.* 70(2): 274-278.
NAL Call Number: 420 En82
Descriptors: feeding, postembryonic development, rearing, environment, *Lygus*, Miridae, food selection, temperature, Heteroptera.

1975

Sevacherian, V. (1975) **Activity and probing behavior of *Lygus hesperus* in the laboratory.** *Annals of the Entomological Society of America.* 68(3): 557-558.
NAL Call Number: 420 En82
Descriptors: environment, *Lygus*, investigation methods, ethology, Hemiptera, insect behavior.

1973

Vepsaelaeinen, K. (1973) **Development rates of some finnish *Gerris fabr.* species (Het. Gerridae) in laboratory cultures.** *Entomologica scandinavica.* 4(3): 206-216. ISSN: 0013-8711.
NAL Call Number: QL461 E59
Descriptors: postembryonic development, environment, *Gerris*, temperature, Hemiptera.

Homoptera

2002

Nair, C.R.; Hayes, J. (2002) **Giant bark Aphids lead to new ecology laboratory exercise.** *Ecological Society of America Annual Meeting Abstracts.* 87: 397-398. Notes: 87th Annual Meeting of the Ecological Society of America and the 14th Annual International Conference of the Society for Ecological Restoration, Tucson, Arizona, USA, August 04-

09, 2002.
NAL Call Number: QH540 E362 2002
Descriptors: terrestrial ecology, environmental biology, Fagaceae, Homoptera, *Longistigma caryae*, giant bark aphid, *Quercus* sp., oaks.

2001

Alla, S.; Moreau, J.P.; Frerot, B. (2001) **Effects of the aphid *Rhopalosiphum padi* on the leafhopper *Psammotettix alienus* under laboratory conditions.** *Entomologia Experimentalis et Applicata.* 98(2): 203-209. ISSN: 0013-8703.
NAL Call Number: 421 EN895
Descriptors: terrestrial ecology, pest assessment control and management, Homoptera, *Psammotettix aleinus*, *Rhopalosiphum padi*, development duration, fecundity, food quality, interspecific interaction, mortality, population density, comparative and experimental morphology, physiology and pathology, environmental biology.

1999

Sengonca, C.; Liu B. (1999) **Laboratory studies on the effect of temperature and humidity on the life table of the whitefly, *Aleurotuberculatus takahashi david* and *subramaniam* (Hom., Aleyrodidae) from southeastern China.** *Anzeiger fuer Schaedlingskunde.* 72(2): 45-48. ISSN: 1436-5693.
NAL Call Number: 421 An9
Descriptors: ecology, pest assessment control and management, population studies, Homoptera, *Aleurotuberculatus takahashi*, whitefly, China, developmental duration, emergence, fecundity, humidity, life table, longevity, temperature, comparative and experimental morphology, physiology and pathology, environmental biology, reproductive system, developmental biology, embryology.

Shah, P.A.; J.A. Pickett; J.D. Vandenberg (1999) **Responses of Russian wheat aphid (Homoptera: Aphididae) to aphid alarm pheromone.** *Environmental entomology.* 28(6): 983-985. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Abstract: In a series of laboratory test, Russian wheat aphids, *Diuraphis noxia* (*mordvilko*), responded to synthetic aphid alarm pheromone, (E)-beta-farnesene, by removing stylets and leaving feeding sites or by crawling out of test arenas. Late instars and adults were more responsive than early instars. In dose-response assays, EC50 estimates ranged from 0.94 to 8.95 mg/ml among 3 experiments. In arenas, *D. noxia* also responded to the proximity of cornicle-damaged nymphs of either the green peach aphid, *Myzus persicae* (*sulzer*), or of *D. noxia*, which suggests endogenous production of alarm pheromone by *D. noxia*. Combinations of (E)-beta-farnesene and the aphid-pathogenic fungus *Paecilomyces fumosoroseus* (*wize*) Brown and Smith did not enhance aphid mortality relative to controls treated with fungus only. Further studies involving appropriate formulations of (E)-beta-farnesene are necessary before practical biorational strategies can be devised combining this semiochemical and biological control agents.
Descriptors: *Diuraphis noxia*, *Myzus persicae*, trauma, alarm pheromones, escape

responses, locomotion, developmental stages, larvae instars, nymphs, mouthparts, removal, dosage effects, mortality, mycoses, *Paecilomyces fumosoroseus*, insect and biological control, (E)-beta-farnesene.

Wolfe, G.R.; C.A. Smith; D.L. Hendrix; M.E. Salvucci (1999) **Molecular basis for thermoprotection in Bemisia: structural differences between whitefly ketose reductase and other medium-chain dehydrogenases/reductases.** *Insect biochemistry and molecular biology.* 29(2): 113-120. ISSN: 0965-1748.
NAL Call Number: QL495.A1I57
Abstract: The silverleaf whitefly (*Bemisia argentifolii*, *bellows* and *perring*) accumulates sorbitol as a thermoprotectant in response to elevated temperature. Sorbitol synthesis in this insect is catalyzed by an unconventional ketose reductase (KR) that uses NADPH to reduce fructose. A cDNA encoding the NADPH-KR from adult *B. argentifolii* was cloned and sequenced to determine the primary structure of this enzyme. The cDNA encoded a protein of 352 amino acids with a calculated molecular mass of 38.2 kDa. The deduced amino acid sequence of the cDNA shared 60% identity with sheep NAD(+)-dependent sorbitol dehydrogenase (SDH). Residues in SDH involved in substrate binding were conserved in the whitefly NADPH-KR. An important structural difference between the whitefly NADPH-KR and NAD(+)-SDHs occurred in the nucleotide-binding site. The Asp residue that coordinates the adenosyl ribose hydroxyls in NAD(+)-dependent dehydrogenase (including NAD(+)-SDH), was replaced by an Ala in the whitefly NADPH-KR. The whitefly NADPH-KR also contained two neutral to Arg substitutions within four residues of the Asp to Ala substitution. Molecular modeling indicated that addition of the Arg residues and loss of the Asp decreased the electric potential of the adenosine ribose-binding pocket, creating an environment favorable for NADPH-binding. Because of the ability to use NADPH, the whitefly NADPH-KR synthesizes sorbitol under physiological conditions, unlike NAD(+)-SDHs, which function in sorbitol catabolism.
Descriptors: *Bemisia argentifolii*, heat stress and tolerance, sorbitol as thermoprotectant, biosynthesis, oxidoreductases, NADPH, complementary DNA, cloning, nucleotide sequences, amino acid sequences, chemical structure, binding sites, enzyme activity, l-iditol-dehydrogenase, Homoptera.

1998

Chu, C.C.; Henneberry, T.J.; Boykin, M.A. (1998) **Response of *Bemisia argentifolii* (Homoptera: Aleyrodidae) adults to white fluorescent and incandescent light in laboratory studies.** *Southwestern Entomologist.* 23(2): 169-181. ISSN: 0147-1724.
NAL Call Number: QL461.S65
Descriptors: terrestrial ecology, Homoptera, *Bemisia argentifolii*, incandescent light, light intensity, white fluorescent, environmental biology, comparative and experimental morphology, physiology and pathology.

Tsueda, H.; Tsuchida, K. (1998) **Differences in spatial distribution and life history parameters of two sympatric whiteflies, the greenhouse whitefly (*Trialeurodes vaporariorum westwood*) and the silverleaf whitefly (*Bemisia argentifolii bellows* and *perring*), under greenhouse and laboratory conditions.** *Applied Entomology and*

Zoology. 33(3): 379-383. ISSN: 0003-6862.
NAL Call Number: SB599 A6
Descriptors: terrestrial ecology, Homoptera, *Bemisia argentifolii*, silverleaf whitefly, *Trialeurodes vaporariorum*, greenhouse whitefly, interspecies mean crowding analysis, greenhouse and laboratory conditions, life history parameters, spatial distribution, survival rate, sympatry, environmental biology, comparative and experimental morphology, physiology and pathology.

1996

Cabette, H.; Soares, R. (1996) **Occurrence of sexual morphs and ambiphasic females of *Schizaphis graminum* (*rondani*) (Homoptera, Aphididae) in the field and in laboratory in Sao Paulo, Brazil.** *Revista Brasileira de Zoologia.* 12(3): 655-662. ISSN: 0101-8175. Note: In Portuguese.
NAL Call Number: QL242 R48
Descriptors: climatology, ecology, morphology, physiology, reproductive system, Homoptera, Aphididae, *Schizaphis graminum*, Brazil, ambiphasic, climatology, female, male, photoperiod, reproductive system, Sao Paulo, sexual morph, environmental biology, bioclimatology and biometeorology, external effects-light and darkness, anatomy and histology, comparative and experimental morphology and physiology.

De Remes, L.A.; Virla, E. (1996) **Description of preimaginal stages of *Delphacodes haywardi* and notes about its behavior under laboratory conditions (Homoptera: Delphacidae).** *Revista de la Sociedad Entomologica Argentina.* 55(1-4): 165-174. ISSN: 0373-5680.
NAL Call Number: 420 So14
Descriptors: behavior, ecology, integumentary system, chemical coordination and homeostasis, morphology, Gramineae, Homoptera, *Cynodon dactylon*, Delphacidae, *Delphacodes haywardi*, *Sorghum halepense*, behavior, coloration pattern, egg viability, female, laboratory conditions, morphology, nymphal instar, reproduction, behavioral biology, environmental biology, physiology and biochemistry, comparative and experimental morphology.

Vaz, N.M.; Young, S.; Hardie, J. (1996) **Laboratory-simulated naturally-decreasing day lengths, twilight and aphid photoperiodism.** *Physiological Entomology.* 21(3): 231-241. ISSN: 0307-6962.
NAL Call Number: QL461.P5
Descriptors: climatology, physiology, Homoptera, aphid, *Aphis fabae*, *Megoura viciae*, biosynchronization, day-length changes, gynopara induction, latitude, male induction, natural day-length simulator, natural day-night cycle, ovipara induction, photoperiodic responses, sexual morph induction, squarewave light-dark cycles, temperature, twilight periods, environmental biology, bioclimatology and biometeorology, comparative and experimental morphology and physiology.

1995

Masters, G.J. (1995) **The impact of root herbivory on aphid performance: field and laboratory evidence.** *Acta Oecologica.* 16(2): 135-142. ISSN: 1146-609X.
NAL Call Number: QH540.A27
Descriptors: development, ecology, nutrition, physiology, reproductive system, Coleoptera, Homoptera, *Phyllopertha horticola*, adult weight, aphid numbers, fecundity, environmental biology, nutritional status and methods, biochemistry, developmental biology, embryology, morphogenesis, comparative and experimental morphology, pathology.

1994

Rasooly, R.; Raccah, B.; Klein, M. (1994) **Laboratory transmission of the citrus stubborn disease agent by a leafhopper from the *Circulifer tenellus* complex from the Jordan Valley.** *Phytoparasitica.* 22(3): 209-218. ISSN: 0334-2123.
NAL Call Number: SB599 P53
Descriptors: ecology, economic entomology, horticulture, immune system, chemical coordination and homeostasis, infection, methods and techniques, physiology, Apocynaceae, Chenopodiaceae, Compositae, Cruciferae, Geraniaceae, Homoptera, Leguminosae, Malvaceae, Plumbaginaceae, Rutaceae, Spiroplasmataceae, eubacteria, bacteria, grapefruit, orange, *Atriplex halimus*, *Beta vulgaris*, *Brassica rapa*, *Carthamus tinctorius*, *Circulifer tenellus*, *Citrus grandis*, *Citrus paradise*, *Citrus sinensis*, *Erodium gruinum*, *Gossypium hirsutum*, *Limonium thouini*, *Matthiola incana*, *Phaseolus vulgaris*, *Plantago major*, Plantaginaceae, *Raphanus sativus*, *Salsola kali*, *Salsola vermiculata*, *Sisymbrium runcinatus*, *Spiroplasma citri*, dicots, Israel, culture medium cultivation, diagnostic method, disease incidence and vector, epidemiology, field method, host records, hybrid oroblanco, immunoassay, immunologic method, little leaf disease, visual inspection, methods, materials and apparatus, environmental biology, phytopathology, comparative and experimental morphology, physiology and pathology.

Zhao, J.W.; Lin, X. (1994) **A study on the biology of *Myzus persicae* (*sulzer*) (Homoptera: Aphidae) under laboratory conditions.** *Wuyi Science Journal.* 11: 17-21. ISSN: 1010-4276.
Descriptors: insect and plant pests, temperature, biology, environmental factors, agricultural entomology, *Myzus persicae*, Aphididae, Sternorrhyncha, Homoptera, Hemiptera, pests of plants, behavior.

1993

De Benedictis, J.A.; Granett, J. (1993) **Laboratory evaluation of grape roots as hosts of California grape *Phylloxera* biotypes.** *American Journal of Enology and Viticulture.* 44(3): 285-291. ISSN: 0002-9254.
NAL Call Number: 390.9 Am33
Descriptors: ecology, economic entomology, horticulture, physiology, reproduction, Homoptera, Rutaceae, Vitaceae, *Aleurocanthus woglumi*, *Citrus reticulate*, acephate,

butocarboxim, diflubenzuron, dimethoate, malathion, methyldemeton, monocrotophos, phosphamidon, environmental biology, biochemistry, comparative and experimental morphology, pathology.

De Remes, L.A.; Virla, E. (1993) **Contribution to the knowledge of the biology of *Dalbulus maidis* (Homoptera: Cicadellidae) under laboratory conditions.** *Neotropica (La Plata).* 39(101-102): 103-109. ISSN: 0548-1686.
Descriptors: agronomy, ecology, economic entomology, infection, microbiology, physiology, reproductive system, Homoptera, *Dalbulus maidis*, developmental stage, egg viability, fertility, longevity, maize virus vector, mortality, survival, temperature effects, environmental biology, physiology and biochemistry, developmental biology, embryology, virology, phytopathology, diseases caused by viruses, comparative and experimental morphology, physiology and pathology.

Khaemba, B.M.; Wanjala, F.M. (1993) **Some aspects of the biology of *Cinara cupressi buckton* (Homoptera: Lachnidae) when bred under laboratory condition.** *Insect Science and its Application.* 14(5-6): 693-695. ISSN: 0191-9040.
NAL Call Number: QL461.I57
Descriptors: ecology, economic entomology, forestry, physiology, reproductive system, Coniferopsida, Gymnospermae, Homoptera, *Cinara cupressi*, Kenya, Africa, Ethiopian region, cypress pest, nymphs, reproduction, environmental biology, biochemistry, developmental biology, embryology, morphogenesis, comparative and experimental morphology, pathology.

Uygun, N.; Sengonca, C.; Ulusoy, M.R. (1993) **Laborstudien des Effektes der Temperatur und der Feuchtigkeit auf Entwicklung und des Fecundity von *Parabemisia myricae* (*kuwana*) (Homoptera: Aleyrodidae). [Laboratory studies of the effect of temperature and humidity on development and fecundity of *Parabemisia myricae* (*kuwana*) (Homoptera: Aleyrodidae).]** *Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz.* 100(2): 144-149. Note: In German.
NAL Call Number: 464.8 Z3
Descriptors: pests, temperature, humidity, development, fecundity, biology, environmental factors, agricultural entomology, Aleyrodidae, Hemiptera, *Parabemisia myricae*, Sternorrhyncha, Homoptera, behavior, pests of plants.

1992

Thirakhupt, V.; Araya, J.E. (1992) **Survival and life table statistics of *Rhopalosiphum padi* (*l.*) and *Sitobion avenae* (*f.*) (Hom., Aphididae) in single or mixed colonies in laboratory wheat cultures.** *Zeitschrift fuer Angewandte Entomologie.* 113(4): 368-375. ISSN: 0044-2240.
NAL Call Number: 421 Z36
Descriptors: population dynamics, survival, reproductive potential, colony, laboratory study, feeding behavior, interspecific competition, *Triticum aestivum*, *Rhopalosiphum padi*, *Sitobion avenae*, pest, controlled environment study, Gramineae, Aphididae, Homoptera.

1991

Murai, T. (1991) **Rearing method for clones of some aphids on tick bean, *Vicia faba*.** *Bulletin of the Shimane Agricultural Experiment Station.* (25): 78-82. ISSN: 0388-905X. Notes: 2 tables; 4 fig.; 16 ref., In Japanese.
Descriptors: *Vicia faba*, *Aphis*, rearing techniques, clones, photoperiodicity, growth, temperature, Aphididae, Aphidoidea, biological development, environmental factors, Hemiptera, Homoptera, Leguminosae, light regimes, lighting, Papilionoideae, progeny, pure lines, Sternorrhyncha.

Sengonca, C.; Kersting, U.; Cinar, A. (1991) **Laboratory studies on development and fecundity of *Circulifer opacipennis* (*lethierry*) (Homoptera: Cicadellidae) an important vector of *Spiroplasma citri saglio* et al. in the Mediterranean area.** *Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz.* 98(6): 650-654.
NAL Call Number: 464.8 Z3
Descriptors: vectors, transmission, pests, plant diseases, biology, environmental factors, plant pathogens and pathology, agricultural entomology, *Circulifer opacipennis*, *Spiroplasma citri*, Cicadellidae, Hemiptera, plant viruses, Mediterranean countries, pests, Rutaceae, Sapindales, dicotyledons, angiosperms, Spermatophyta, Spiroplasma, Mycoplasmatales, Mollicutes, Tenericutes, bacteria, prokaryotes, Auchenorrhyncha, Homoptera, viruses, biogenic diseases.

1990

Chavez, S.A.; Lapointe, S.L.; Zuluaga, J.I. (1990) **Effect of temperature and relative humidity on storage of eggs of *Zulia colombiana lallemand* (Homoptera: Cercopidae) under laboratory conditions.** *Revista Colombiana de Entomologia.* 16(1): 31-38. ISSN: 0120-0488.
NAL Call Number: QL481.C7R4
Descriptors: temperature, relative humidity, rearing techniques, storage, biology, environmental factors, agricultural entomology, Hemiptera, Cercopidae, *Zulia colombiana*, Brachiaria, Colombia, Auchenorrhyncha, Homoptera, Gramineae, Cyperales, monocotyledons, angiosperms, Spermatophyta, South America, America, pests, pathogens and biogenic diseases, techniques and methodology.

Kalmar, G.; Kuroli, G. (1990) **Laboratory studies on the growth and reproduction of *Sitobion avenae f.* (Homoptera; Aphididae).** *Acta phytopathologica.* 25(1-4): 433-438. ISSN: 0001-6780.
NAL Call Number: SB731.A3
Descriptors: embryonic development, laboratory study, duration, temperature effects, pest, environmental factor, *Sitobion avenae*, Aphididae, Aphidoidea, Homoptera.

Krysan, J.L. (1990) **Laboratory study of mating behavior as related to diapause in overwintering *Cacopsylla pyricola* (Homoptera: Psyllidae).** *Environmental entomology.* 19 (3): 551-557. ISSN: 0046-225X.
NAL Call Number: QL461.E532

Descriptors: mating, diapause, overwintering, laboratory study, pest, fruit tree, environmental factor, *Cacopsylla pyricola*, Psyllidae, Psylloidea, Homoptera.

Wilkaniec, B. (1990) **Rozwój (opracowywanie) rózowego jablka *aphid* ludnosc pod laboratorium (laboratoryjny) i teren (polowy) warunki. [Development of the rosy apple aphid population under laboratory and field conditions.]** *Zeszyty problemowe postepow nauk rolniczych.* (392): 65-70. ISSN: 0084-5477. Note: In Polish.
NAL Call Number: 20.5 Z5
Descriptors: population dynamics, temperature, fecundity, survival, laboratory study, study under natural conditions, Aphididae, pest, environmental factor, Homoptera.

1989

Kisimoto, R. (1989) **Flexible diapause response to photoperiod of a laboratory selected line in the small brown planthopper, *Laodelphax striatellus fallen*.** *Applied Entomology and Zoology.* 24(1): 157-159. ISSN: 0003-6862.
NAL Call Number: SB599 A6
Descriptors: *Laodelphax*, diapause, photoperiodicity, Auchenorrhyncha, Delphacidae, developmental stages, dormancy, environmental factors, Fulgoroidea, Hemiptera, Homoptera, light regimes, lighting.

Valle, R.R.; Kuno, E.; Nakasuji, F. (1989) **Competition between laboratory populations of green leafhoppers, *Nephotettix* spp. (Homoptera: Cicadellidae).** *Researches on population ecology.* 31(1): 53-72. ISSN: 0034-5466.
NAL Call Number: 420 K99
Descriptors: *Nephotettix*, population studies, ecology, interspecies competition, temperature dependence, model, indoor environment, Deltcephalidae, leafhopper, Homoptera, Hemiptera, Pterygota, community, group, struggle for survival, biological interaction, dependence, environment in building.

1988

Radcliffe, E.B.; W.M. Tingey; R.W. Gibson; L. Valencia; K.V. Raman (1988) **Stability of green peach aphid (Homoptera: Aphididae) resistance in wild potato species.** *Journal of economic entomology.* 81(1): 361-367. ISSN: 0022-0493.
NAL Call Number: 421 J822
Abstract: In a series of 39 field and laboratory experiments, relative resistance to green peach aphid (GPA), *Myzus persicae* (*sulzer*), was determined for 82 potato accessions representing 42 wild species. Field experiments were done at two locations in Minnesota and one location each in New York and Peru; laboratory experiments were done in Minnesota, England, and Peru. Aphid populations used were of five origins: Minnesota, New York, England, Puerto Rico, and Peru. Stability of green peach aphid resistance was consistent across test locations and GPA populations. No accession differed significantly from its overall mean resistance index in more than one test environment. Most significant deviations occurred in experiments with Peruvian and Puerto Rican GPA populations, although there was little evidence that either population represented biotypes

different from the GPA populations of Minnesota, New York, or England. Apparently, if GPA-resistant breeding lines were developed, they could be used widely and this resistance would prove stable.
Descriptors: *Solanum tuberosum*, species, wild plants, cultivars, pest resistance, *Myzus persicae*, Hemiptera, England, Minnesota, New York, Peru, Puerto Rico, field and laboratory studies.

1987

Meyerdirk, D.E.; Moratorio, M.S. (1987) ***Circulifer tenellus* (*baker*), the beet leafhopper (Homoptera: Cicadellidae): laboratory studies on fecudity and longevity.** *Canadian Entomologist.* 119(5): 443-447. ISSN: 0008-347X.
NAL Call Number: 421 C16
Descriptors: natural enemies, temperature, rearing techniques, sugarbeet, parasitoids, hosts, biology, environmental factors, root crops, vegetables, agricultural entomology, *Anagrus giraulti*, Hymenoptera, Mymaridae, Hemiptera, Cicadellidae, *Circulifer tenellus*, *Beta vulgaris var. saccharifera*, Auchenorrhyncha, Homoptera, Beta, Chenopodiaceae, Caryophyllales, pests of plants, techniques and methodology, biological control.

Nozato, K. (1987) **[Population growth of the melon aphid, *Aphis gossypii glover* (Homoptera: Aphididae) during the winter season in the warmer region of Japan and effects of temperature on the reproduction of the aphid in the laboratory Japan.]** *Japanese Journal of Applied Entomology and Zoology.* 31(2): 162-167. ISSN: 0021-4914. Notes: 9 ref., In Japanese.
NAL Call Number: 475 J27
Descriptors: plants, *Aphis*, population density, Japan, reproduction, winter, environmental temperature effects, laboratory experiments, Asia, environment, environmental conditions, Hemiptera, Homoptera, periodicity, physiological functions, seasonal effects, population, timing.

Rotundo, G.; Giacometti, R. (1987) **The sex pheromone of *Phenacoccus gossypii town.* and *ckll.* (Homoptera, Pseudococcidae): partial purification and its biological activity under laboratory conditions.** *Bollettino del laboratorio di entomologia agrarian Filippo Silvestri.* 43(suppl.): 195-202. ISSN: 51845X.
NAL Call Number: 420 P82B
Descriptors: life history, treatment, juvenile hormone, female, sex pheromone, insect wind tunnel, controlled environment study, Pseudococcidae, Coccoidea, Homoptera.

1986

O'doherty, R. (1986) **Cold hardiness of laboratory-maintained and seasonally-collected populations of the black bean aphid, *Aphis fabae scopoli* (Homoptera: Aphididae).** *Bulletin of entomological research.* 76(3): 367-374. ISSN: 0007-4853.
NAL Call Number: 421 B87
Descriptors: Homoptera, tolerance, cold, supercooling, host plant, pest, temperature,

environmental factor, Leguminosae, Celastraceae, *Aphis fabae*, *Vicia faba*.

Prophetou-Athanasiadou, D.A.; Tzanakakis, M.E. (1986) **Diapause termination in the olive psyllid *Euphyllura phillyreae*, in the field and in the laboratory.** *Entomologia experimentalis et applicata.* 40(3): 263-272. ISSN: 0013-8703.
NAL Call Number: 421 En895
Descriptors: Homoptera, fruit crop, diapause, photoperiod, temperature, season, Greece, pest, Psyllidae, environmental factor, *Olea europea*, Europe.

1984

Kuroli, G. (1984) **Laboratory investigation of the ontogenesis of oat aphid (*Rhopalosiphum padi l.*).** *Zeitschrift fuer angewandte Entomologie.* 97(1): 71-76. ISSN: 0044-2240.
NAL Call Number: 421 Z36
Descriptors: Homoptera, cereal crop, postembryonic development, fecundity, temperature, tolerance, Aphididae, pest, environmental factor, life history, reproduction, *Rhopalosiphum padi*.

Murdoch, W.W.; Scott, M.A. (1984) **Stability and extinction of laboratory populations of zooplankton preyed on by the backswimmer *Notonecta*.** *Ecology.* 65(4): 1231-1248. ISSN: 0012-9658.
NAL Call Number: 410 Ec7
Descriptors: zooplankton, freshwater environment, predation, predator prey relation, population dynamics, Homoptera, Notonectidae.

1982

Takada, H. (1982) **Influence of photoperiod and temperature on the production of sexual morphs in a green and a red form of *Myzus persicae* (*sulzer*) (Homoptera, Aphididae). I: Experiments in the laboratory.** *Konchu.* 50(2): 233-245. ISSN: 0013-8770.
NAL Call Number: 421 K833
Descriptors: Homoptera, photoperiod and temperature effects, sexual insect, Aphididae, *Myzus persicae*, environmental factor, polymorphism.

Van Rensburg, G.D. (1982) **Laboratory observations on the biology of *Cicadulina mbila* (*naude*) (Homoptera: Cicadellidae), a vector of maize streak disease. I: The effect of temperature.** *Phytophylactica.* 14(3): 99-107. ISSN: 0370-1263.
NAL Call Number: SB599.L35
Descriptors: Homoptera, phytopathogen vector, temperature, life history, laboratory study, Cicadellidae, maize streak virus, plant pest, environmental factors.

1981

Wilson, S.W.; Mcpherson, J.E. (1981) **Descriptions of the immature stages of *Bruchomorpha oculata* with notes on laboratory rearing.** *Annals of the Entomological Society of*

America. 74(4): 341-344. ISSN: 0013-8746.
NAL Call Number: 420 En82
Descriptors: morphology, pest of plants, rearing, environmental factor, Fulgoroidea, Homoptera, Issidae, developmental stages.

1980

De Klerk, C.A.; Giliomee, J.H.; Ben-Dov, Y. (1980) **Biology of *Margarodes capensis giard* (Homoptera: Coccoidea: Margarodidae) under laboratory and controlled conditions in South Africa.** *Phytophylactica.* 12(3): 147-156. ISSN: 0370-1263.
NAL Call Number: SB599.L35
Descriptors: life history, pest, laboratory study, environmental factor, Homoptera, reproduction, South Africa, viticulture.

1977

Campbell, A.; Mackauer, M. (1977) **Reproduction and population growth of the pea aphid (Homoptera: Aphididae) under laboratory and field conditions.** *The Canadian entomologist.* 109(2): 277-284.
Descriptors: statistical analysis, Aphididae, population dynamics, environment, fecundity, longevity, aphid populations, temperature effects, ecology, Homoptera.

1975

Fields, G.J.; Zwick, R.W. (1975) **Elimination of ovarian diapause in pear *Psylla*, *Psylla pyricola* (Homoptera: Psyllidae), in the laboratory.** *Annals of the Entomological Society of America.* 68(6): 1037-1038. ISSN: 0013-8746.
NAL Call Number: 420 En82
Descriptors: diapause, dormancy, environment, photoperiod, Psyllidae, temperature effects, reproduction.

1973

Rose, D.J. (1973) **Laboratory observations on the biology of *Cicadulina* spp. (Hom., Cicadellidae), with particular reference to the effects of temperature.** *Bulletin of entomological research.* 62(3): 471-476. ISSN: 0007-4853.
NAL Call Number: 421 B87
Descriptors: postembryonic development, environment, temperature effects.

Hymenoptera

2004

Devillers, J.; Dore, J.C.; Tisseur, M.; Cluzeau, S.; Maurin, G. (2004) **Modelling the flight activity of Apis mellifera at the hive entrance.** *Computers and Electronics in Agriculture.* 42(2): 87-109. ISSN: 0168-1699.
NAL Call Number: S494.5.D3C652
Descriptors: climatology, models and simulations, computational biology, Hymenoptera, *Apis mellifera,* flight activity, artificial neural network model, mathematical and computer techniques, co-inertia analysis, electronic bee counters, palinological analysis, laboratory techniques, partial least squares regression, principal component analysis, co-structures, data matrices, global radiation, hive entrance, outgoing bee data, mathematical biology and statistical methods, ecology, environmental biology, France.

Duchateau, M.J.; Velthuis, H.H.; Boomsma, J.J. (2004) **Sex ratio variation in the bumblebee Bombus terrestris.** *Behavioral Ecology.* 15(1): 71-82. ISSN: 1045-2249.
Descriptors: behavior, evolution and adaptation, reproduction, terrestrial ecology, Hymenoptera, *Bombus terrestris,* bumblebee, path analysis, laboratory techniques, colony development and life cycle, diapause duration, reproductive parameters and strategies, sex allocation patterns, kin selection perspective, sex ratio variation, evolution, comparative study, environmental biology.

Ellis, H.A. (2004) ***Quadrastichus lasiocerus* (*graham*) (Hym., Eulophidae, Tetrastichinae) reared from *Wachtliella persicariae* (*l.*) (Dipt., Cecidomyiidae) galls on *Persicaria amphibia* (*l.*) S.F. Gray in Northumberland.** *Entomologist's Monthly Magazine.* 139(1676-78): 37-38. ISSN: 0013-8908.
NAL Call Number: 421 En86
Descriptors: ecology, environmental biology, Diptera, Hymenoptera, *Wachtliella persicariae*, *Quadrastichus lasiocerus*, *Persicaria amphibian*, Northumberland, UK, Europe.

Heil, M.; Baumann, B.; Krueger, R.; Linsenmair, K.E. (2004) **Main nutrient compounds in food bodies of Mexican Acacia ant-plants.** *Chemoecology.* 14(1): 45-52. ISSN: 0937-7409.
NAL Call Number: No call number available; located in stacks.
Descriptors: terrestrial ecology, Hymenoptera, Macaranga, *Pseudomyrmex, Acacia chiapensis, Acacia collinsii, Acacia cornigera, Acacia globulifera, Acacia hindsii,* amino acids, carbohydrates, fatty acids, glycogen, lipids, nutrients, proteins, chromatographic techniques, laboratory techniques, ant-plant interaction, chemoecology, indirect defense, mutualism, environmental biology.

Jennings, M. (2004) **Parasitoids reared from galls of *Phanacis hypochoeridis* (*kieffer, 1887*), *P. centaureae foerster*, *1860*, and *P. caulicola* (*hedicke, 1939*) (Hymenoptera: Cynipidae).** *Entomologist's Gazette.* 55(1): 67-70. ISSN: 0013-8894.
NAL Call Number: 421 EN834

Descriptors: ecology, Hymenoptera, *Centaurea scabiosa,* Compositae, *Phanacis caulicola, Phanacis centaureae, Phanacis hypochoeridis,* galls, parasitism, environmental biology.

Kanbar, G.; Engels, W. (2004) **Visualisation by vital staining with trypan blue of wounds punctured by *Varroa destructor* mites in pupae of the honey bee (Apis mellifera).** *Apidologie.* 35(1): 25-29. ISSN: 0044-8435.
NAL Call Number: SF521.A64
Descriptors: parasitology, terrestrial ecology, Acarina, Hymenoptera, *Varroa destructor,* mite, *Apis mellifera,* honey bee, hemolymph, blood and lymphatics, Chelicerates, trypan blue, vital staining, histology and cytology techniques, laboratory techniques, parasite-host relations, puncture wounds, wound visualization, environmental biology.

Maschwitz, U.; Go, C.; Kaufmann, E.; Buschinger, A. (2004) **A unique strategy of host colony exploitation in a parasitic ant: Workers of Polyrhachis lama rear their brood in neighbouring host nests.** *Naturwissenschaften.* 91(1): 40-43. ISSN: 0028-1042.
NAL Call Number: 474 N213
Descriptors: terrestrial ecology, Hymenoptera, *Diacamma* sp., Hymenoptera, *Polyrhachis lama,* brood rearing, host colony exploitation, reproductive division, social parasitism, environmental biology, comparative study, morphology, physiology, pathology.

Moritz, R.F.; Neumann, P. (2004) **Differences in nestmate recognition for drones and workers in the honeybee, *Apis mellifera* (*l.*).** *Animal Behavior* 67(4): 681-688. ISSN: 0003-3472.
NAL Call Number: 410 B77
Descriptors: behavior, molecular genetics, biochemistry and molecular biophysics, population genetics, population studies, reproduction, terrestrial ecology, environmental biology, *Apis mellifera,* honeybee, Hymenoptera, female, male, drone, nestmate, queen, worker, DNA microsatellite loci, methods and equipment, genotyping, genetic techniques, laboratory techniques, colony integrity, emigration, immigration, nestmate recognition, odor cues, polyandry.

Riabinin, K.; Kozhevnikov, M.; Ishay, J.S. (2004) **Ventilating activity at the hornet nest entrance.** *Journal of ethology.* 22(1): 49-53. ISSN: 0289-0771.
NAL Call Number: QL750.J68
Descriptors: ventilation, nest, hive, worker insect, temperature regulation, room temperature, *Vespa orientalis,* laboratory study, animal construction, environmental factor, Vespidae, Aculeata.

Ronhede, S.; Boomsma, J.J.; Rosendahl, S. (2004) **Fungal enzymes transferred by leaf-cutting ants in their fungus gardens.** *Mycological Research* 108 (1): 101-106, ISSN: 0953-7562.
NAL Call Number: QK600.M82
Descriptors: enzymology, biochemistry and molecular biophysics, terrestrial ecology, Hymenoptera, *Acromyrmex echinatior,* leaf-cutting ant, *Atta colombica,* carboxymethylcellulase, laccase, pectinase, protease, isoelectric focusing, electrophoretic and laboratory techniques, specific staining, histology and cytology, ant fungus garden,

mycelial colonization, environmental biology.

Webster, T.C.; Pomper, K.W.; Hunt, G.; Thacker, E.M; Jones, S.C. (2004) **Nosema apis infection in worker and queen *Apis mellifera*.** *Apidologie.* 35(1): 49-54. ISSN: 0044-8435.
NAL Call Number: SF521.A64
Descriptors: infection, ecology, Hymenoptera, *Nosema apis,* pathogen, *Apis mellifera,* honeybee, queen, worker, primer sequences, DNA extraction, genetic and laboratory techniques, light microscopy, polymerase chain reaction, environmental biology, biochemistry, nucleic acids, purines and pyrimidines, comparative study.

2002

Pankiw, T.; Tarpy, D.R.; Page, R.E. (2002) **Genotype and rearing environment affect honeybee perception and foraging behavior.** *Animal Behavior.* 64(4): 663-672. ISSN: 0003-3472.
NAL Call Number: 410 B77
Descriptors: bees, *Apis mellifera*, colony level, selection, division of labor, response thresholds, phenotypic plasticity, task specialization, sucrose, polyethism, age.

Salles, H.C. (2002) **A method for rearing immature stages of *Apis melifera* outside the colony (Hymenoptera : Apidae).** *Sociobiology.* 39(2): 187-193. ISSN: 0361-6525.
NAL Call Number: QH549.S6
Descriptors: *Apis mellifera*, development, experimental condition, environment for developing immature stages, honeybee.

2001

Buyukguzel, K. (2001) **DNA gyrase inhibitors: Novobiocin enhances the survival of *Pimpla turionellae* (Hym., Ichneumonidae) larvae reared on an artificial diet but other antibiotics do not.** *Journal of Applied Entomology.* 125(9-10): 583-587. ISSN: 0931-2048.
NAL Call Number: 421 Z36
Descriptors: Hymenoptera, larvae culture, entomology, developmental biologics.

Quiran, E.M.; Steibel, J.P. (2001) ***Acromyrmex lobicornis emery 1887* body and load weight relationship. A laboratory experience.** *Gayana.* 65(2): 113-118. Note: In Spanish.
NAL Call Number: 450 G25
Descriptors: Hymenoptera, *Acromyrmex lobicornis*, artificial nest, laboratory equipment, ant colonies, body weight, ecological processes, environmental conditions, foraging distance, leaf harvesting, load weight, nutritional demands, plant chemical composition, general and comparative behavior, behavioral biology, comparative and experimental morphology and physiology.

2000

Fisher, P.J.; Stradling, D.J.; Watling, R.; Frankland, J.C.; Ainsworth, A.M.; Isaac, S.; Robinson, C. H. (2000) **Tropical Mycology Macromycetes.** *Laboratory studies with Leucoagaricus and attine ants.* CABI Publishing, Selected Papers of the Millennium Symposium on Tropical Mycology, Liverpool, England, UK. April, 2000, Sponsor: British Mycological Society, p 113-130. ISBN: 0-85199-542-X (cloth).
NAL Call Number: QK615.7 T76 2002
Descriptors: terrestrial ecology, environmental biology, biosystematic names, Basidiomycetes, Hymenoptera, *Atta cephalotes*, *Leucoagaricus gongylophorus*.

Mohammedi, A.; Le Conte, Y. (2000) **Do environmental conditions exert an effect on nest-mate recognition in queen rearing honey bees?** *Insectes Sociaux.* 47(4): 307-312. ISSN: 0020-1812.
NAL Call Number: 421 IN79
Descriptors: honey bees, nest-mate recognition, kinship, queen rearing, *Apis mellifera*, discrimination, kin, frequencies.

Plateaux-Quenu, C.; Plateaux, L.; Packer, L. (2000) **Population-typical behaviors are retained when eusocial and non-eusocial forms of *Evylaeus albipes* (*f.*) (Hymenoptera, Halictidae) are reared simultaneously in the laboratory.** *Insectes Sociaux.* 47(3): 263-270. ISSN: 0020-1812.
NAL Call Number: 421 IN79
Descriptors: behavior, terrestrial ecology, Hymenoptera, *Evylaeus albipes*, eusocial form, female, male, non-eusocial form, France, Europe, eusociality, laboratory rearing, overwintering, photoperiod, population-typical behaviors, social evolution, temperature, environmental biology, comparative and experimental morphology and physiology.

1999

Goodisman, M.A.; P.D. Mack; D.E. Pearse; K.G. Ross (1999) **Effects of a single gene on worker and male body mass in the fire ant *Solenopsis invicta* (Hymenoptera:Formicidae).** *Annals of the Entomological Society of America.* 92(4): 563-570. ISSN: 0013-8746.
NAL Call Number: 420 En82
Abstract: This study examines the effects of general-protein-9 (Gp-9) genotype on the body mass of polygyne (multiple-queens per nest) *Solenopsis invicta buren* workers and males. We found that Gp-9 genotype was significantly associated with variation in worker mass in field but not laboratory colonies. Moreover, triploid workers with 2 distinguishable genotypes (Gp-9(BBb) and Gp-9(Bbb)) weighed significantly more than diploid workers with the heterozygous genotype (Gp-9(Bb)). Our results, combined with those obtained from previous studies, indicate that Gp-9 genotype, ploidy, social form, and colony queen number affect mass of S. invicta workers. We also discovered that Gp-9 genotype significantly influenced the mass of haploid males reared in both field and laboratory environments. As a group, polygyne males were significantly lighter than monogyne males, even when Gp-9 genotype was taken into account, indicating that

social environment interacts with Gp-9 genotype to influence male mass. Given that diploid males previously have been shown to be lighter than haploid males, 3 factors (Gp-9 genotype; social form, and ploidy) are now known to affect the mass of male fire ants.
Descriptors: *Solenopsis invicta*, structural genes, genotypes, genetic effects, body weight, caste, males, ploidy, polygyny, general-protein-9 (Gp-9) genotype.

Harbo, J.R.; J.W. Harris (1999) **Heritability in honey bees (Hymenoptera: Apidae) of characteristics associated with resistance to *Varroa jacobsoni* (Mesostigmata: Varroidae).** *Journal of economic entomology.* 92(2): 261-265. ISSN: 0022-0493.
NAL Call Number: 421 J822
Abstract: This study uses sibling analysis to measure the heritability in honey bees, *Apis mellifera l.*, of characteristics that have been associated with resistance to the mite, *Varroa jacobsoni oudemans*. Twenty-eight uniform colonies of bees were established on 13 May in Baton Rouge, LA, each with 1 kg of mite-infested bees and a queen. The 28 unrelated queens in these colonies were divided into 7 groups of 4 based on the insemination of 4 queens with the same mixture of semen from 1 of 7 sire colonies. After worker progeny from these queens had replaced the initial bee populations, a colony was related as a full sister to the other 3 colonies in its sire group and unrelated to the other 24 colonies. Heritability (h(2)) was 1.24 for proportion of mites in brood, 0.65 for hygienic behavior, 0.89 for the duration of the capped period, 0.46 for suppression of mite reproduction, and 0.00 for physical damage to mites (measured by the presence of physically broken or dented mites on the bottom board). These results suggest that it should be possible to enhance the expression of 4 of these 5 characteristics with selective breeding of bees, thus reinforcing confidence in our ability to breed honey bees for resistance to *V. jacobsoni*.
Descriptors: *Apis mellifera*, *Varroa jacobsoni*, pest resistance, genetic resistance, heritability, genetic analysis, honey bee colonies, sibling analyses.

Paleolog, J.; Akademia, R.L.; Katedra, B.P.; Flis, W.; Pszczelarskie, P.W. (1999) **Wpływ (wywierac wpływ na) *genotypes* i srodowiska zachowania tablicy do nalepiania reklam w *honey* *bee* w laboratorium (laboratoryjny) i teren (polowy) próby. [Influence of genotypes and environments of hoarding behavior in honey bee in the laboratory and field tests.]** *Annales Universitatis Mariae Curie-Sklodowska. Sectio EE Zootechnica.* 17: 289-294. ISSN: 0239-4243. Notes: 3 fig.; 10 ref., In Polish.
NAL Call Number: SF84 A56
Abstract: Worker-bees from different colonies were introduced to weeding hives and placed under isolators with outdoor feeders to study whether hoarding behavior estimated in laboratory is similar to this shown in the field and how environment and genotypes influenced these correlations. Two repetitions, one during good and second during poor weather conditions were carried out. The cage test was also perforated to worker-bees from the colonies to compare results obtained under laboratory and field conditions. CAU were worse than CAR under good and they were a little bit better under poor conditions (interactions). CAR were the best in the laboratory (BC) were similar to CAU. Results obtained in laboratory tests were different from those obtained in the field. It was easier to estimate differences between genotypes in laboratory but it was impossible to answer which of those genotypes should preferred.

Descriptors: worker bees, genotypes, behavior, environmental factors, honey bee colonies, hoarding behavior, useful insects.

1998

Brown, P.E.; Frank, C.P.; Groves, H.L.; Anderson, M. (1998) **Spectral sensitivity and visual conditioning in the parasitoid wasp *Trybliographa rapae* (Hymenoptera: Cynipidae).** *Bulletin of Entomological Research.* 88: 239–245. ISSN: 0007-4853.
NAL Call Number: 421 B87
Descriptors: *Trybliographa rapae*, parasitoid wasp, spectral sensitivity, visual conditioning.

Hu, J.S.; S.B. Vinson (1998) **The in vitro development from egg to prepupa of *Campoletis sonorensis* (Hymenoptera: Ichneumonidae) in an artificial medium: importance of physical factors.** *Journal of insect physiology.* 44(5/6): 455-461. ISSN: 0022-1910.
NAL Call Number: 421 J825
Abstract: A further attempt to improve the in vitro rearing of the solitary larval endoparasitoid *Campoletis sonorensis* (Hymenoptera: Ichneumonidae) was made after third instars were obtained in previous studies. Respiration was an important factor for the parasitoid's continued development: both small diet volumes that exposed the larval cuticle to air and O2 greatly improved growth and development of *C. sonorensis*. Fifth instars were obtained when the parasitoid larvae were reared in medium volumes of 0.25 ml and 0.1 ml per well. Increasing the O2 tension of the air resulted in larger larvae and prepupae. The agar layer under the nutritional medium was designed to slowly remove water from the diet. The results indicated that a drier environment was important for the parasitoid at the terminal stage. One percent and 0.8% agar gels, which removed water from the diet more rapidly, provided a drier environment and resulted in improved larval growth compared to the 0.6% agar gel. The detrimental effect of higher concentration of chicken egg yolk mixed in the diet was eliminated by using a dry egg yolk layer covered by an agar layer. This sandwich technique resulted in more parasitoid larvae molting to the final larval instar (5th) and the formation of many prepupae. However, the development of prepupae was premature and none of the fifth instar larvae successfully formed a normal cocoon.
Descriptors: *Campoletis sonorensis*, rearing techniques, in vitro, culture media, volume, oxygen, hatching, growth, biological development, parasitoids.

Hrassnigg, N.; K. Crailsheim (1998) **The influence of brood on the pollen consumption of workers bees (*Apis mellifera l.*).** *Journal of insect physiology.* 44(5/6): 393-404. ISSN: 0022-1910.
NAL Call Number: 421 J825
Abstract: (1) In midgut dry weight (tissue plus contents) of worker bees we found a representative parameter for pollen consumption. Midguts of bees of successive ages were analyzed and correlated with various parameters. The relative proportions of sugar, protein and water were either constant or negatively correlated with midgut weight. Only the relative pollen weight (percent of midgut dry weight) increased. (2) To investigate the influence of different levels of brood on pollen consumption of individual bees, midgut dry weights from 2 normally breeding control colonies and 2 brood-reduced experimental

colonies were analyzed. In bees from control colonies the pollen consumption increased up to the nursing age (3-10 d), remained on an elevated level in middle-aged-bees (10-18 d) and decreased relatively sharply towards the foraging ages (> 21 d). When queens were caged in the experimental colonies, the following decline of brood cells affected the consumption of pollen differently. After 6 days of caging, with a reduction of open brood only, no effect was seen. After 15 days, and even more pronounced after 23 days when no brood was present, the pollen consumption in young and middle-aged (10, 14, 18 d) worker bees was significantly reduced, while it was clearly elevated in older bees. We discuss pollen consumption as an adaptation to reduced necessity to nurse brood in young and middle-aged bees, and to enhance life span in older animals.
Descriptors: *Apis mellifera*, worker honey bees, pollen, intake, feeding behavior, midgut, weight, water content, protein content, sugars, honey bee brood, age differences, brood care.

Quiran, E.M.; Molas, B.M. (1998) **Vuelo de Nuptial y fundación de las colonias de los lobicornis de *Acromyrmex* (himenópteros: Formicidae) en laboratorio, en la provincia de la pampa del la, la Argentina. [Nuptial flight and colonies foundation of *Acromyrmex lobicornis* (Hymenoptera: Formicidae) in laboratory, in La Pampa province, Argentina.]** *Revista de la Sociedad Entomologica Argentina.* 57(1-4): 67-70. ISSN: 0373-5680. Note: In Spanish.
NAL Call Number: 420 So14
Descriptors: terrestrial ecology, environmental biology, Hymenoptera, *Acromyrmex lobicornis*, La Pampa province, Argentina, colonies formation, nuptial flight, behavioral biology.

Walin, L.; L. Sundstrom; P. Seppa; R. Rosengren (1998) **Worker reproduction in ants--a genetic analysis.** *Heredity.* 81(6): 604-612. ISSN: 0018-067X.
NAL Call Number: 443.8 H42
Abstract: Workers of social insects may enhance their inclusive fitness by laying unfertilized eggs that develop into males. In particular, workers may gain from rearing worker-produced males if their average relatedness to them exceeds their relatedness to queen-produced males. These relatedness values depend both on the queen mating frequency and on the number and relatedness of nestmate queens. We examined the occurrence of worker reproduction in field colonies of four ant species of the genera *Formica* and *Myrmica*. Based on relatedness arguments alone, worker reproduction was expected in all species because of low queen mating frequency, or low effective queen numbers. Nevertheless, genotype matching of workers and males showed that worker reproduction was absent or rare in two of the three *Formica* species studied here. In *M. ruginodis*, queens may have been the sisters of the workers in many cases, which means that workers of this species may regularly rear nephews. In the three species in which worker reproduction was not found, workers bias colony sex ratios to enhance their inclusive fitness. We therefore hypothesize that sex ratio biasing and male production may be mutually exclusive strategies for workers.
Descriptors: *Myrmica ruginodis*, *Formica rufa*, queens, worker ants colonies, worker ant produced males, mating frequency, genetic markers, genotypes, genetic analysis, paternity, sex ratio, sexual reproduction, isoenzymes, loci, alleles, enzyme polymorphism, Finland.

1997

Dawes-Gromadzki, T.Z.; Bull, C.M. (1997) **Laboratory studies of ant predation on parapatric reptile ticks.** *Australian Journal of Ecology.* 22(1): 1-7. ISSN: 0307-692X.
NAL Call Number: QH540.A8
Descriptors: ecology, environmental biology, physiology, Acarina, Chelicerata, Hymenoptera, *Amblyomma limbatum*, *Iridomyrmex*, *Rhytidoponera*, Australasian region, parasite, predation, reptile tick, terrestrial ecology, nutritional status and methods.

Grbic, M.; D. Rivers; M.R. Strand (1997) **Caste formation in the polyembryonic wasp *Copidosoma floridanum* (Hymenoptera: Encyrtidae): in vivo and in vitro analysis.** *Journal of insect physiology.* 43(6): 553-565. ISSN: 0022-1910.
NAL Call Number: 421 J825
Abstract: The polyembryonic wasp *Copidosoma floridanum* produces two morphologically distinct types of larvae in its host *Trichoplusia ni*. Reproductive larvae consume the host, pupate, and form adult wasps, whereas precocious larvae manipulate the sex ratios of the reproductive caste and defend the brood against interspecific competitors. Previous study indicated that morphogenesis of the reproductive caste was associated with a 9-day competency period, and that ecdysteroids of host origin were required for completion of embryogenesis. Here we investigated whether factors associated with the host environment mediate morphogenesis of precocious larvae and caste determination. Embryogenesis of precocious larvae was found to be synchronized with specific stages of the host first-fourth instars. However, development of precocious larvae did not depend on environmental factors specifically associated with these host stages. Elevation of the host juvenoid titer using the analogue methoprene induced *T. ni* to undergo a supernumerary sixth instar, but did not alter the proportion of wasp embryos that developed into precocious and reproductive larvae. In contrast, embryos competent to initiate morphogenesis developed into precocious larvae when transplanted into novel host stages such as pupae. Development of precocious larvae was arrested by ablation of the host's source of ecdysteroids, but could be rescued dose-dependently by injection of 20-hydroxyecdysone. In vitro rearing studies confirmed that completion of embryogenesis of the precocious caste required an exogenous pulse of 20-hydroxyecdysone. Combined with previous studies, our results indicate that embryos forming precocious and reproductive larvae acquire the competence to undergo morphogenesis at different times. However, we find no evidence to suggest that caste determination is mediated by environmental factors associated with a specific stage of the host.
Descriptors: *Copidosoma*, caste determination, polyembryony, larvae, dimorphism, embryonic development, morphogenesis, timing, methoprene, ecdysterone, hormonal control, parasitoids, host parasite relationships, *Trichoplusia ni*, developmental stages, in vitro.

Messing, R.H.; Klungness, L.M.; Jang, E.B. (1997) **Effects of wind on movement of *Diachasmimorpha longicaudata*, a parasitoid of tephritid fruit flies, in a laboratory flight tunnel.** *Entomologia experimentalis et applicata.* 82(2): 147-152. ISSN: 0013-8703.
NAL Call Number: 421 EN895

Descriptors: flight, locomotion, wind, parasitoid active movement and activity, velocity, pest, laboratory study, Braconidae, Tephritidae, parasitism, environmental factor, Hymenoptera.

Williams, R.S.; Lincoln, D.E.; Thomas, R.B. (1997) **Effects of elevated CO_2-grown loblolly pine needles on the growth, consumption, development, and pupal weight of red-headed pine sawfly larvae reared within open-topped chambers.** *Global Change Biology.* 3(6): 501-511. ISSN: 1354-1013.
NAL Call Number: QC981.8.C5G6323
Descriptors: elevated CO_2, leaf nitrogen monoterpenes, *Neodiprion lecontei*, *Pinus taeda*, pupal weight, carbon dioxide atmospheres, insect herbivore interactions, enriched CO_2 atmospheres, western spruce budworm, *Taeda* l seedlings, nutritional ecology, nutrient balance, *Junonia coenia*, water stress, Lepidoptera, Hymenoptera.

1996

Calderone, N.W.; R.E. Page Jr. (1996) **Temporal polyethism and behavioral canalization in the honey bee, *Apis mellifera*.** *Animal behavior.* 51(3): 631-643. ISSN: 0003-3472.
NAL Call Number: 410 B77
Abstract: Two models of temporal polyethism in the honey bee were evaluated. The developmental-programme model asserts a causal relationship between age and task performance. The foraging-for-work model asserts that this relationship is an epiphenomenon associated with a self-organizing system. The effect of a worker's pre-foraging environment on task selection as a forager was also examined. Four groups of workers, emerging at 6-day intervals, were introduced to a colony. Workers in group 1 were introduced when less than 12 h old. Workers in groups 2 and 3 were divided into deprived and non-deprived groups. Non-deprived groups were introduced to the colony when less than 12 h old. Deprived groups were confined to an incubator for 12 days and 6 days, respectively, then introduced to the colony along with group 4 (< 12 h old). Foraging activities were quantified for two sets of workers from strains of bees selected for high and low pollen hoarding. The results support the developmental-programme model. Non-deprived workers began foraging in the order that they were introduced. Deprived workers from groups 2 and 3 began to forage before younger workers in group 4, even though all three groups were introduced to the colony at the same time. The results also suggest that a forager's task selection is primarily determined by her genotype and immediate environment. High-strain workers collected pollen more often than low-strain workers, regardless of their pre-foraging environments. Differences between deprived and non-deprived groups of the same strain and age were rare.
Descriptors: *Apis mellifera*, social behavior, age, forager's task selection, colonies, work sharing, genotypes, environment, deprived and non-deprived groups.

1995

Danka, R.G.; J.D. Villa; T.E. Rinderer; G.T. Delatte (1995) **Field test of resistance to *Acarapis woodi* (Acari: Tarsonemidae) and of colony production by four stocks of honey bees (Hymenoptera: Apidae).** *Journal of economic entomology.* 88(3): 584-591. ISSN:

0022-0493.
NAL Call Number: 421 J822
Abstract: Characteristics of four stocks of honey bees, *Apis mellifera l.*, were evaluated in colonies managed commercially for honey production at three U.S. locations-one north-central location (Iowa) and two south-central locations (Mississippi, Texas). Stocks were compared for 1 yr beginning in October 1991 to determine the levels of infestation by tracheal mites, *Acarapis woodi* (*rennie*), and to ascertain survival rates, levels of honey production, and sizes of adult and brood populations. Test stocks were ARS-Y-C-1 (*A. mellifera carnica pollman*, imported from Yugoslavia), *buckfast* (imported from the United Kingdom), *survivor* (developed from colonies in a Louisiana apiary believed to have had severe tracheal mite infestation), and *unchallenged* (developed from a feral Louisiana population never exposed to tracheal mites). Stocks initially were represented by 15-20 colonies at each location. After an initial inoculation of mite-infested bees in the autumn, infestation percentages increased more markedly in the susceptible (*survivor* and *unchallenged*) stocks than in the resistant (*ARS-Y-C-1* and *buckfast*) stocks. Mean infestation percentages in the resistant stocks remained <15% and thus were below levels associated with economic damage. Mean infestation percentages in susceptible stocks ranged from 13 to 95% at each site during the final 6 mo of the study. Numbers of mites per infested bee differed between stocks in 4 of 21 samples; mite numbers tended to be greatest in *survivor* bees and least in *buckfast* bees. Mortality increased more rapidly among susceptible colonies than among resistant colonies as infestation increased in 1992. Honey production was greatest by *buckfast*, intermediate by *survivor*, and least by *unchallenged* and *ARS-Y-C-1* colonies. Differences in population sizes of adult bees and brood occurred in approximately half of samples taken in spring and autumn; *survivor* and *buckfast* colonies were most populous. Stock characteristics showed no interaction of genotype with environment, i.e., location. Our results support the feasibility of an approach using genetically regulated resistance to manage problems caused by tracheal mites.
Descriptors: *Apis mellifera carnica*, *Acarapis woodi*, infestation with tracheal mites, honey bee colonies, honey bee brood, parasitism, survival, honey, production, host strain differences, pest resistance, Iowa, Mississippi, Texas, infestation analysis.

Herrera, C.M. (1995) **Floral biology, microclimate, and pollination by ectothermic bees in an early-blooming herb.** *Ecology.* 76(1): 218-228. ISSN: 0012-9658.
NAL Call Number: 410 Ec7
Abstract: Abiotic factors may constrain the functioning of species interactions such as plant-pollinator mutualisms. I investigated how thermal environment affects the interaction between the early-blooming daffodil, *Narcissus longispathus* (Amaryllidaceae) and its major bee pollinator (*Andrena bicolor*; Andrenidae), focusing simultaneously on plant and pollinator sides of the interaction. I studied fruit and seed set, flower duration, and the intrafloral thermal environment of *N. longispathus*, and the thermal biology, foraging behavior, and thermoregulatory ability of *A. bicolor*, over a 6-yr period in southeastern Spain. *N. longispathus* flowers from February to April, when unsuitable weather often limits pollinator activity, yet most flowers are successfully pollinated in all years and sites. Fruit set was weakly pollen limited, but among flowers setting fruit the proportion of ovules developing into seeds was not. Individual flowers lasted for 17 d on average, remaining functional during this period. On sunny days, the

air inside *N. longispathus* flowers was significantly warmer than outside. Mean temperature excess inside flowers was as high as 8 degrees C, and was positively related to solar irradiance. Within flowers, air temperature was highest around the anthers; this intrafloral gradient was consistent with variation among perianth parts in radiation transmittance. Andrena bicolor foraged in *N. longisapthus* flowering patches only on sunny days with air temperature > 12 degrees - 13 degrees C, and foraging behavior and flower visitation rate were temperature dependent. Bees were able to fly at relatively low thoracic temperatures (Tth; range 22 degrees - 31 degrees C) and this was essential for successfully foraging at *N. longispathus*. Under the range of irradiance and air temperature found at foraging sites, A. bicolor individuals inside flowers were able to reach Tth suitable for flight by passive means alone. Under laboratory conditions, A. bicolor was unable to raise or otherwise regulate Tth by physiological means, but free-flying individuals thermoregulated behaviorally. Basking was used to raise Tth, and intrafloral microclimate, by influencing the proportion of foraging time devoted to basking, played an important role in thermoregulation. Flower visitation rate was positively related to the average temperature inside visited flowers, and the probability of basking immediately after one floral visit declined with increasing flower temperature. I conclude that the favorable microclimate within *N. longispathus* flowers, their long duration, and the thermal biology of *A. bicolor*, were critical elements in this early-season pollination system.
Descriptors: *Narcissus longispathus*, *Andrena bicolor*, foraging, pollination, flowering, seed set, fruits, environmental factors, microclimate, air temperature, bee body temperature, thermoregulation, phenology, Spain.

Macom, T.E.; Porter, S.D. (1995) **Food and energy requirements of laboratory fire ant colonies (Hymenoptera: Formicidae).** *Environmental Entomology*. 24(2): 387-391. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: ecology, economic entomology, fire ant metabolism, food requirements, nutrition, physiology, Campanulaceae, Hymenoptera, *Solenopsis invicta*, bioenergetics, environmental biology.

Perez-Lachaud, G.; M. Campan (1995) **Influence of previous sexual experience and post-emergence rearing conditions on the mating behavior of *Chryseida bennetti*.** *Entomologia experimentalis et applicata*. 76(2): 163-170. ISSN: 0013-8703.
NAL Call Number: 421 En895
Descriptors: Hymenoptera, Eurytomidae, mating behavior, social environment, mating frequency, parasitoids, parasites of insect pests, *Acanthoscelides obtectus*, laboratory rearing, copulation.

Ready, C.C.; Vinson, S.B. (1995) **Seed selection by the red imported fire ant (Hymenoptera: Formicidae) in the the laboratory.** *Environmental Entomology*. 24(6): 1422-1431. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: fire ant behavior, development, ecology, economic entomology, nutrition, physiology, reproduction, Campanulaceae, Gramineae, Hymenoptera, Labiatae, Leguminosae, Fabaceae, Meliaceae, *Solenopsis invicta*, *Zea mays*, competition,

germination, seed dispersal, seed predation, seed size, environmental biology, biochemistry and biophysics, comparative and experimental laboratory study.

Schmidt, L.S.; J.O. Schmidt; H. Rao; W. Wang; L. Xu (1995) **Feeding preference and survival of young worker honey bees (Hymenoptera: Apidae) fed rape, sesame, and sunflower pollen.** *Journal of economic entomology.* 88(16): 1591-1595. ISSN: 0022-0493.
NAL Call Number: 421 J822
Abstract: Young worker honey bees, *Apis mellifera l.*, exhibited differences in feeding preferences and survival when fed pollen of rape, *Brassica napus l.*, sesame, *Sesamum indicum l.*, and sunflower, *Helianthus annuus*. Rape pollen was readily consumed and increased longevity 2.5 times relative to the controls fed only sucrose water. Sunflower pollen was readily consumed with bees on average surviving 1.6 times longer than the controls. Sesame pollen was not readily consumed and bees survived 1.7 times longer than the controls. The results suggest that honey bees used to pollinate monoculture crops of either sunflowers or sesame, but not rape, will need to be provided alternate floral or nutritional supplements source to enrich their diets and maintain colony health.
Descriptors: *Apis mellifera*, worker honey bees, feeding preferences, *Brassica napus*, *Sesamum indicum*, *Helianthus annuus*, pollen food effects on survival and longevity.

1994

Inoue, M.; Ueda, M.; Ai, N. (1994) **[Laboratory lesson for physiolosical [sic] study on respiration-modified strategy for estimation about oxgen consumption on respiration.]** *Japanese Journal of Biological Education.* 34(4): 314-327. ISSN: 0287-119X. Note: In Japanese.
Descriptors: science education, respiration, Formicidae, oxygen consumption and demand, teaching material, mean value, education and training, Hymenoptera, Pterygota, environmental quality index, index number, numerical value.

Tsuji, K. (1994) **Inter-colonial selection for the maintenance of cooperative breeding in the ant *Pristomyrmex pungens*: A laboratory experiment.** *Behavioral Ecology and Sociobiology.* 35(2): 109-113. ISSN: 0340-5443.
NAL Call Number: QL751.B4
Descriptors: ecology, evolution and adaptation, nutrition, physiology, reproduction, Hymenoptera, *Pristomyrmex pungens*, behavior, colony competition, foraging, natural selection, parthenogenesis, social structure, evolution, environmental biology, nutritional status and methods, biochemistry, comparative and experimental morphology.

Vinson, S.B.; A.K. Mourad.; D.K. Sebesta (1994) **Sources of possible host regulatory factors in *Cardiochiles nigriceps* (Hymenoptera: Braconidae).** *Archives of insect biochemistry and physiology.* 26(2/3): 197-209. ISSN: 0739-4462.
NAL Call Number: QL495.A7
Abstract: Both larvae and teratocytes liberated upon hatching from the eggs of the endoparasitoid *Cardiochiles nigriceps viereck* were found to release proteins into their surrounding environment as they develop. Teratocytes were found to synthesize and release a number of proteins into culture media in which they were incubated. The

proteins released differed among the different teratocyte ages. Larvae were also found to release proteins into the culture media in which they were incubated. Ligation of the head or anal vesicle altered the protein pattern found in the media. The results demonstrate that both larvae and the associated teratocytes release proteins that may have important functions in the parasitoid-host interaction.
Descriptors: *Heliothis virescens*, *Cardiochiles nigriceps*, parasitoids, larvae and teratocytes release proteins, cells, growth regulators, ligation of head or anal vesicle.

1993

Barrera, J.F.; Infante, F.; Alauzet, C.; Gomez, J.; De La Rosa, W.; Castillo, A. (1993) **Biology of *Cephalonomia stephanoderis betrem* (Hymenoptera: Bethylidae) in the laboratory: II. Development cycle, sex ratio, adult longevity and life expectancy.** *Cafe Cacao The.* 37(3): 205-214. ISSN: 0007-9510.
NAL Call Number: 68.8 C112
Descriptors: development, ecology, economic entomology, horticulture, parasitology, physiology, reproductive system, Coleoptera, Hymenoptera, Rubiaceae, *Cephalonomia stephanoderis*, *Hypothenemus hampei*, biological control, coffee bean pest, environmental biology, biochemistry, developmental biology, embryology, morphogenesis, comparative and experimental morphology, pathology.

Chuda-Mickiewicz, B.; Prabucki, J. (1993) **Próba (usilowac) stwierdzac wplyw *drone* *rearing* czas (obliczac) na wartosci *inseminated* *honeybee* królowe. [Attempt to ascertain the influence of the drone rearing time on value of inseminated honeybee queens.]** *Pszczelnicze Zeszyty Naukowe.* 37: 41-49. ISSN: 0552-4563. Notes: 18 ref., In Polish.
NAL Call Number: 424.8 P954
Abstract: An attempt was undertaken to ascertain the influence of the drone rearing time on value of inseminated honeybee queens. A total of 2770 drones and 150 honeybee queens were examined directly through qualifying the quality of their semen, as well as indirectly through judging the queens, inseminated at different times in the season. The results obtained showed that the drones reared in June and used for insemination in the middle of July were the most valuable while those reared in July and used in August were the least valuable. The filling of the spermatheca as well as the beginning of oviposition of queens inseminated at different times of the season, seem to be more dependent on environment factors than on the time in which the drones were reared.
Descriptors: queen bees, drones, breeds, artificial insemination, seasons, summer, environmental factors, honeybee husbandry, methods, bee colonies, mating systems, reproduction control, seasons, taxa, useful insects.

Collett, T.S.; S.N. Fry; R. Wehner (1993) **Sequence learning by honeybees.** *Journal of comparative physiology. A, Sensory, neural, and behavioral physiology.* 172(6): 693-706. ISSN: 0340-7594.
NAL Call Number: QP33.J68
Abstract: Bees of several genera make foraging trips on which they visit a series of plants in a fixed order. To help understand how honeybees might acquire such routes, we examined whether (1) bees learn motor sequences, (2) they link motor instructions to

visual stimuli, (3) their visual memories are triggered by contextual cues associated with the bees' position in a sequence. 1. Bees were trained to follow a complex route through a series of obstacles inside a large, 250 cm by 250 cm box. In tests, the obstacles were briefly removed and the bees continued to fly the same zig-zag trajectory that they had when the obstacles were present. The bees' complex trajectory could reflect either the performance of a sequence of motor instructions or their attempt to reach fixed points in their environment. When the point of entry to the box was shifted, the bees' trajectory with respect to the new point of entry was relatively unchanged, suggesting that bees have learnt a motor sequence. 2. Bees were trained along an obstacle course in which different flight directions were associated with the presence of different large patches of colour. In tests, the order of coloured patches was reversed, the trajectory followed by the bees was determined by the order of colours rather than by the learnt motor sequence suggesting that bees will readily link the performance of a particular trajectory to an arbitrary visual stimulus. 3. Bees flew through a series of 3 similar compartments to reach a food reward. Passage from one compartment to the next was only possible through the centre of one of a pair of patterns, e.g. white + ve vs. black - ve in the first box, blue + ve vs. yellow - ve in the second, vertical + ve vs. horizontal - ve in the last. In some tests, bees were presented with a white vs. a vertical stimulus in the front compartment, while, in other tests, the same pair of stimuli was presented in the rear compartment. Bees preferred the white stimulus when tested in the first compartment, but chose the vertical stimulus in the last compartment. Bees reaching a compartment are thus primed to recall the stimulus which they normally encounter there. We argue that the elements which are linked together to form a route are "path-segments", each of which takes a bee for a given distance in a given direction.
Descriptors: *Apis mellifera*, worker honey bees, foraging, learning, vision, obstacle route training, path segment, navigation.

Le Moli, F.; Grasso, D.A.; D'Ettorre, P.; Mori, A. (1993) **Intraspecific slavery in *Polyergus rufescens latr.* (Hymenoptera, Formicidae): field and laboratory observations.** *Insectes Sociaux.* 40(4): 433-437. ISSN: 0020-1812.
NAL Call Number: 421 IN79
Descriptors: development, ecology, physiology, Hymenoptera, *Polyergus rufescens*, dulosis, ant slave raid, ant slave-makers, behavioral biology, environmental biology, developmental biology, embryology, intraspecific interactions.

Obin, M.S.; Morel, L.; Vander, M., Robert, K. (1993) **Unexpected, well-developed nestmate recognition in laboratory colonies of polygyne imported fire ants (Hymenoptera: Formicidae).** *Journal of Insect Behavior.* 6(5): 579-589. ISSN: 0892-7553.
URL: http://www.wkap.nl/journalhome.htm/0892-7553
NAL Call Number: QL496.J68
Descriptors: ant environments, genetics, kinship recognition, aggressive behavior in ants, laboratory vs. field maintenance, nestmate recognition, polygene, imported fire ants, social and instinctive behavior.

Vivas-Rodriguez, J.A.; Cabrera-Cauich, D.A.; Medina-Medina, L.A.; Baeza-Rodriguez, J.J. (1993) *Biological components to nectar and pollen gathering. III. Environmental effect on brood rearing and food storage.* Guadalajara, Jal. (Mexico) , 27-30 Sep 1993,

National Reunion on Animal Research. Jalisco 1993 (Summaries), CENID Microbiologia, Mexico, D.F., Sep 1993, p. 65, Notes: Meeting, CENID Microbiologia. Apdo. Postal 41-652. Mexico, D.F. 05110, In Spanish.
Descriptors: honeybees, Africanized bees, apiculture, honeycombs, Yucatan, America, honeybee husbandry, beehives, Mexico, useful insects.

1992

Bromenshenk, J.J.; Cronn, R.C.; Nugent, J.J. (1992) *Ecological indicators, Vols 1 and 2.* Surveillance monitoring of the Idaho National Engineering Laboratory with honey bees. Univ. Mont., Missoula, MT 59812. (2): 1522-1523. ISBN: 1-85166-722-9 (set); 1-85166-711-3 (vol. 1); 1-85166-721-0 (vol. 2). Note: Conference/Meeting: International Symposium Fort Lauderdale, Florida, October 16-19, 1990.
NAL Call Number: TD193.2 E26 1992
Descriptors: climatology, pathology, pollution assessment control and management, toxicology, Hymenoptera, anthropogenic chemicals, contaminant exposure, ecological indicators, environmental monitoring, industrial emissions, pollution effects, spatial trends, ecology, environmental biology, bioclimatology and biometeorology, toxicology methods and experimental, environmental and industrial toxicology, public health, environmental health, air, water and soil, comparative and experimental morphology, physiology.

Salmanova, L.M.; Chernyshev, V.B.; Olifer, V.V.; Grinberg, S.M.; Afonina, V.M. (1992) **Gradual changes of *Trichogramma* in the course of laboratory rearing (*Trichogramma evanescens*): (Hymenoptera, Trichogrammatidae).** *Zoologicheskii Zhurnal.* 71(10): 90-96. ISSN: 0044-5134.
NAL Call Number: 410 R92
Descriptors: development, parasitology, physiology, Hymenoptera, Lepidoptera, *Mamestra brassicae*, *Sitotroga cerealella*, *Trichogramma evanescens*, beneficial species, biological control, flight, kairomone response, natural host, parasite efficiency, spontaneous jumping, behavioral biology, insect communication, ecology, environmental biology, developmental biology, embryology, morphogenesis, comparative and experimental morphology, biochemical studies, movement, endocrine system, economic entomology.

1991

Ledwa, W. (1991) **Fehlerhaftes Aufrichten (Einziehen) und Verluste der Biene Kolonien. [Erroneous rearing (feeding) and losses of bee colonies.]** *Schweizerische Bienen Zeitung.* 114(10): 588-591. ISSN: 0036-7540. Notes: 2 photographs, In German.
NAL Call Number: 424.8 SCH9
Descriptors: Apidae, bee colonies, *Varroa*, *Acariasis*, nectar, pest control, biotopes, Acarina, Arachnida, environments, honeybees, Hymenoptera, Mesostigmata, parasitoses, plant secretions, useful insects, Varroidae.

Wardle, A.R.; J.H. Borden (1991) **Effect of prior experience on the response of *Exeristes***

***roborator* (Hymenoptera: Ichneumonidae) to a natural host and microhabitat in a seminatural environment.** *Environmental entomology.* 20(3): 889-898. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Abstract: In a field cage, the responses of females of the polyphagous ichneumonid ectoparasitoid *Exeristes roborator* (*f.*) to a natural host and microhabitat were reduced by prior experience with the same host in an artificial microhabitat. Learning of the artificial microhabitat probably interfered with females' normal responses to the natural system. Parasitoids that had previously attacked hosts in the artificial microhabitat contacted the natural system in fewer numbers and performed host-seeking and host-attacking activities on it with lower intensity than control females. They also killed fewer host larvae than controls. Thus, rearing procedures that permit parasitoids produced for release as biological control agents to gain experience with nontarget hosts and microhabitats could impair these insects' effectiveness against target pests. Prior experience with the natural host and microhabitat did not increase females' responses to them. This result could reflect the way in which learning functions for E. roborator. Learning might allow the parasitoid to use unusual or less preferred hosts when its normal hosts are rare but not to enhance its responses to hosts for which it has a strong innate preference. Learning may have caused E. roborator to respond almost exclusively to the natural host and microhabitat when it was familiar with them. Fidelity to a target system caused by prior exposure to it might enhance a biological control agents' performance over a longer term than was examined here.
Descriptors: *Pinus sylvestris*, *Rhyacionia buoliana*, *Exeristes roborator*, parasites of insect pests, field cage, ectoparasitoid, effectiveness of artificially reared wasps, habitats, host seeking behavior, British Columbia.

1990

Martin, P. (1990) **Respiration d'une colonie d'unifasciatus de *Leptothorax* (*latr.*) élevé dans le laboratoire. [Respiration of a colony of *Leptothorax unifasciatus* (*latr.*) reared in the laboratory.]** *Actes des Colloques Insectes Sociaux.* (6): 219-226. ISSN: 0256-0076.
Note: In French.
Descriptors: environmental factors, temperature, social insects, physiology, respiration, insect physiology and biochemistry, agricultural entomology, *Leptothorax unifasciatus*, Hymenoptera, Formicidae, Belgium, pests of plants, insect physiology and biochemistry.

Moli, F. le; Mori, A. (1990) **Laboratory experiments on environmental sources of nestmate and non-nestmate discrimination in three species of *Formica* ants (Hymenoptera: Formicidae).** *Psyche.* 97(3-4): 147-169. ISSN: 0033-2615.
NAL Call Number: 421 P95
Descriptors: social insects, diets, biology, behavior, agricultural entomology, *Formica cunicularia*, Hymenoptera, *Formica lugubris*, *Formica rufa*, Italy, pests.

1989

Abdullah, M.; Dawah, H.A.; Jervis, M.A. (1989) **New rearing records for the parasitoids**

***Homoporus subniger* (*walker*), *H. febriculosus* (*girault*) and *Merisus splendidus walker* (Hymenoptera: Pteromalidae).** *Entomologist's Gazette.* 40(4): 325-327. ISSN: 0013-8894.
NAL Call Number: 421 EN834
Descriptors: *Dactylis glomerata*, useful insects, natural enemies, habitats, Pteromalidae, parasites, hosts, biological competition, British Isles, environments, Gramineae, Hymenoptera, noxious insects, parasitism, pests, Western Europe.

Bindokas, V.P.; Gauger, J.R.; Greenberg, B. (1989) **Laboratory investigations of the electrical characteristics of honey bees and their exposure to intense electric fields.** *Bioelectromagnetics.* 10(1): 1-12. ISSN: 0197-8462.
Descriptors: bioelectric phenomena, electric field effects, honey bee electrical characteristics, *Apis mellifera*, intense electric fields, vibrations, wings, antennae, body hairs, behavior, conductive substrate, voluntary movements, lower thorax, legs, enhanced current density, insulator, bee impedance, step-potential-induced currents, 60 Hz, 240 nA, 1 Mohm, bioelectricity, biological effects of radiations.

Goussard, F.; Geri, C. (1989) **Un élevage continu du pini l. de Diprion dans le laboratoire. [A continuous rearing of *Diprion pini l.* in laboratory.]** *Agronomie.* 9(9): 911-918. ISSN: 0249-5627. Notes: 28 ref., In French.
NAL Call Number: SB7.A3
Descriptors: *Pinus sylvestris*, diprion, diapause, lighting, laboratory rearing techniques, biological development, conifers, crops, economic plants, environmental control, gymnosperms, Hymenoptera, physiological functions, Pinaceae, structural crops, timber trees.

1988

Brown, P.E.; Frank, C.P.; Groves, H.L.; Anderson, M. (1988) **Spectral sensitivity and visual conditioning in the parasitoid wasp *Trybliographa rapae* (Hymenoptera: Cynipidae).** *Bulletin of Entomological Research.* 88: 239–245. ISSN: 0007-4853.
NAL Call Number: 421 B87
Descriptors: *Trybliographa rapae*, parasitoid wasp, spectral sensitivity, visual conditioning.

Hall, R.D.; Fischer, F.J. (1988) **Laboratory studies on the biology of *Spalangia nigra* (Hym.: Pteromalidae).** *Entomophaga.* 33(4): 495-503. ISSN: 0013-8959.
NAL Call Number: 421 En835
Descriptors: host-parasite relation, host selection, development, parasitism rate, temperature, sex ratio, longevity, entomophagous, laboratory study, environmental factors, *Spalangia nigra*, *Musca domestica*, *Stomoxys calcitrans*, parasitoid, Pteromalidae, Chalcidoidea, Hymenoptera, Muscidae, Diptera.

Herard, F.; Keller, M.A.; Lewis, W.J. (1988) **Rearing *Microplitis demolitor wilkinson* (Hymenoptera: Braconidae) in the laboratory for use in studies of semiochemical mediated searching behavior.** *Journal of Entomological Science.* 23(2): 105-111. ISSN: 0749-8004.

NAL Call Number: QL461 G4
Descriptors: natural enemies, temperature, environmental factors, humidity, sex ratio, rearing techniques, parasitoids, hosts, techniques, agricultural entomology, *Microgaster demolitor*, Lepidoptera, Noctuidae, Hymenoptera, Braconidae, *Helicoverpa zea*, biological control, techniques and methodology, pests.

Kfir, R.; Hamburg, H.van (1988) **Interspecific competition between *Telenomus ullyetti* (Hymenoptera: Scelionidae) and *Trichogrammatoidea lutea* (Hymenoptera: Trichogrammatidae) parasitizing eggs of the cotton bollworm *Heliothis armiger* in the laboratory.** *Environmental Entomology.* 17(4): 664-670. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: temperature, natural enemies of plant pests, photoperiod, relative humidity, parasitoids, hosts, cotton, fields, interactions, environmental factors, *Telenomus ullyetti*, *Trichogrammatoidea lutea*, Noctuidae, Lepidoptera, Hymenoptera, Scelionidae, *Helicoverpa armigera*, *Gossypium*, South Africa, Malvaceae, Malvales, Africa South of Sahara, pathogens and biogenic diseases, biological control.

Kolodny-Hirsch, D.M. (1988) **Influence of some environmental factors on the laboratory production of *Cotesia melanoscela* (Braconidae: Hymenoptera): a larval parasitoid of *Lymantria dispar*.** *Environmental Entomology.* 17(1): 127-131. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: temperature, sex ratio, light, natural enemies of insect forest pests, biology, environmental factors, parasitoids, hosts, rearing techniques, *Apanteles melanoscelus*, Lepidoptera, *Lymantria dispar*, *Cotesia melanoscelus*, Braconidae, Hymenoptera, biological control, silviculture, pathogens and biogenic diseases, techniques and methodology.

Rami, K. fir; Van Hamburg, H. (1988) **Interspecific competition between *Telenomus ullyetti* (Hymenoptera: Scelionidae) and *Trichogrammatoidea lutea* (Hymenoptera: Trichogrammatidae) parasitizing eggs of the cotton bollworm *Heliothis armiger* in the laboratory.** *Environmental entomology.* 17(4): 664-670. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: interspecific competition, multiparasitism, temperature, parasite, entomophagous, laboratory study, Oophagous, environmental factor, Scelionidae, Trichogrammatidae, *Heliothis armigera*, parasitoid, Hymenoptera, Chalcidoidea, Noctuidae, Lepidoptera.

Southerland, M.T. (1988) **The effects of temperature and food on the growth of laboratory colonies of *Aphaenogaster rudis emery* (Hymenoptera: Formicidae).** *Insectes Sociaux.* 35(3): 304-309. ISSN: 0020-1812.
NAL Call Number: 421 IN79
Descriptors: temperature effects, social insects, diets, biology, environmental factors, *Aphaenogaster rudis*, Hymenoptera, Formicidae, pests, pathogens and biogenic diseases, ants.

Sureerat, P.; Siriwat, W. (1988) *Queen rearing with Apis cerana in Thailand.* Programme and Abstracts 14th Conference on Science and Technology of Thailand, Chulalongkorn

Univ., Bangkok (Thailand): 422-423. ISBN: 974-86840-3-2. Note: In English and Thai. *Abstract*: Queen rearing with *Apis cerana* in Thailand is a new technology in selection and breeding program. The method for rearing queens of *A. mellifera* was applied to *A. cerana* queen rearing at the Bee Biology Research Unit, Chulalongkorn University, where up to 90 % of the transplanted larvae were accepted during swarming season and less than 30% were accepted during the rainy season and lack of food. Production of queen rearing with *A. cerana* by single grafting were compared with double grafting. There was no significant difference between two methods (at 95 % level). Only the external environment factors were important effects for queen rearing with *A. cerana*. Descriptors: queen bee rearing, *Apis cerana*, apiculture, environmental factors, yields, Thailand, animal husbandry, Apidae, Asia, honeybees, Hymenoptera, South East Asia, useful insects, Bee Biology Research Unit, Chulalongkorn University.

1987

Adashkevich, B.P.; Saidova, E.K. (1987) **[Features of the development of *Habrobracon hebetor* (Hymenoptera, Braconidae) during rearing in the laboratory.]** *Zoologicheskii Zhurnal.* 66(10): 1509-1515. ISSN: 0044-5134. Note: In Russian.
NAL Call Number: 410 R92
Descriptors: temperature, humidity, natural enemies, pests, fecundity, ecology, development, heat sums, parasitoids, hosts, biology, environmental factors, *Galleria mellonella*, USSR, Bracon, Braconidae, Hymenoptera, Pyralidae, Lepidoptera, biological control, pathogens and biogenic diseases, development in artificial rearing.

Mintzer, A.C. (1987) **Primary polygyny in the ant *Atta texana*: number and weight of females and colony foundation success in the laboratory.** *Social Insects.* 34(2): 108-117.
Descriptors: *Atta texana*, Formicidae, weight, effect on survival and colony success, polygamy, cooperative colony foundation success, reproductive productivity, female founder weight relationships, colony formation, female colony founders, related to body weight, biometrics, reproduction, behavior, ecology, population dynamics, Aculeata, Apocrita, Hymenoptera.

1986

Obin, M.S. (1986) **Nestmate recognition cues in laboratory and field colonies of *Solenopsis invicta buren* (Hymenoptera: Formicidae). Effect of environment and role of cuticular hydrocarbons.** *Journal of chemical ecology.* 12(9): 1965-1975. ISSN: 0098-0331.
NAL Call Number: QD415.A1J6
Descriptors: *Solenopsis invicta*, discrimination, colonies, odors, cuticles, hydrocarbons, communication between insects, aggressive behavior.

1985

Adashkevich, B.P.; Umarova, T.M. (1985) **Peculiarities of the development of *Trichogramma***

***principium* (Hymenoptera, Trichogrammatidae) under laboratory conditions.** *Zoologicheskii Zhurnal.* 64(9): 1413-1417. ISSN: 0044-5134.
NAL Call Number: 410 R92
Descriptors: natural enemies, parasites, hosts, ecology, environmental factors, *Trichogramma principium*, Lepidoptera, *Sitotroga cerealella*, USSR, biological control, pests, developmental changes, artificial rearing.

Filho, B.F. do Amaral (1985) **Contribuicao ao conhecimento do ciclo biologico de Venturia canescens (Gravenhorst, 1829) (Hymenoptera, Ichneumonidae) sob condicoes de laboratorio. [Contribution to the knowledge of the biological cycle of *Venturia canescens* (*gravenhorst, 1829*) (Hymenoptera, Ichneumonidae) under laboratory conditions.]** *Anais da Sociedade Entomologica do Brasil.* 14(1): 17-22. ISSN: 0301-8059. Note: In Portuguese.
NAL Call Number: QL461.S64
Descriptors: *Ephestia kuehniella*, Pyralidae, hymenopteran parasites, *Venturia canescens*, parasite life cycle, Ichneumonidae, developmental stages, duration, longevity, Lepidopteran hosts, environmental influences on life cycle, abiotic factors, life cycle relationship, parasites diseases and disorders, Heteroneura, Glossata, Terebrantia, Apocrita.

1984

Grant, J.F.; Shepard, M. (1984) **Laboratory biology of *Meteorus autographae* (Hymenoptera: Braconidae), an indigenous parasitoid of soybean looper (Lepidoptera: Noctuidae) larvae.** *Environmental entomology.* 13(3): 838-842. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: Lepidoptera, Hymenoptera, oil plant, development, temperature, host parasite relation, laboratory study, fecundity, parasite efficiency, pest, Noctuidae, Braconidae, entomophagous, *Pseudoplusia includens*, *Glycine max*, Leguminosae.

Liu, S.S.; Hughes, R.D. (1984) **The relationships between temperature and rate of development in two geographic stocks of *Aphidius sonchi* in the laboratory.** *Entomologia experimentalis et applicata.* 36(3): 231-238. ISSN: 0013-8703.
NAL Call Number: 421 En895
Descriptors: Hymenoptera, parasite, Homoptera, development, temperature, laboratory study, Aphidiidae, pest, environmental factor, entomophagous, weed, *Sonchus oleraceus*, Compositae.

Yadav, R.P.; Chaudhary, J.P. (1984) **Laboratory studies on the biology of *Ooencyrtus papilionis ashmead* (Hymenoptera: Encyrtidae), an egg-parasitoid of the sugarcane leaf hopper (*Pyrilla perpusilla walker*).** *Journal of Entomological Research (New Delhi).* 8(2): 162-166. ISSN: 0378-9519.
NAL Call Number: QL483.I4J6
Descriptors: *Ooencyrtus papilionis*, Encyrtidae, egg number, duration, laboratory, emergence from pupa, Hemipteran hosts, *Pyrilla perpusilla*, population sex ratio, seasonal environmental effects, humidity, temperature, seasonal variation effects on life cycle, Lophopidae, Hymenopteran parasites, reproductive productivity, development,

metamorphosis, parasites diseases and disorders, hosts, population dynamics, Chalcidoidea, Terebrantia, Apocrita, Fulgoroidea, Auchenorrhyncha, Homoptera, true bugs, parasitoids.

1982

Beassem, J. (1982) *Étude de laboratoire de l'effet des facteurs eco-physiologiques sur la biologie des flavipes d'Apanteles (came.) (Hym :Braconidae) développé sur le zacconius Blesz de Chilo. (Lep : Pyralidae). [Laboratory study of the effect of eco-physiological factors on the biology of Apanteles flavipes (Cam.) (Hym: Braconidae) grown on Chilo zacconius Blesz. (Lep: Pyralidae).]* Ec. Natl. Super. Agron. University, Montpellier, Degree: Thesis, Doct.: Agron. 137 f.-22 pl. Note: In French.
Descriptors: Hymenoptera, parasite, Lepidoptera, temperature, humidity, feeding, host parasite relation, *Apanteles flavipes*, Braconidae, Pyralidae, pest, entomophagous, environmental factor.

1981

Turillazzi, S.; Conte, A. (1981) **Temperature and caste differentiation in laboratory colonies of *Polistes foederatus* (*kohl*) (Hymenoptera Vespidae).** *Monitore zoologico italiano.* 15(4): 275-297. ISSN: 0026-9786.
NAL Call Number: QL1 M6
Descriptors: caste differentiation, temperature, environmental factor, Hymenoptera, *Polistes foederatus*, social polymorphism, Vespidae, ethology.

1977

Bilewicz-Pawinska, T. (1977) **Time reduction of diapause of parasitic *Peristenus foerster* (Hymenoptera) under laboratory conditions.** *Bulletin de l'Academie polonaise des sciences. Serie des sciences biologiques.* 25(5): 301-305. ISSN: 0001-4087.
NAL Call Number: 512 W262
Descriptors: Braconidae, postembryonic development, diapause, environment, temperature.

Vesely, V. (1977) **First experience with rearing the honey-bees in controlled-environment room.** *Vedecke Prace Vyzkumneho Ustavu Vcelarskeho.* (8): 113-131. Notes: 2 tables; 10 ref., Dol u Libcic, In Czech.
Descriptors: Honey-bees (*Apis mellifera*), laboratory rearing conditions.

1974

Varma, G.C.; Bindra, O.S. (1974) **Laboratory studies on host-parasite relationships of two *Apanteles* species when reared on *Chilo partellus* (*swinhoe*).** *Indian journal of entomology.* 36(2): 110-112. ISSN: 0367-8288.
NAL Call Number: 420 IN23

Descriptors: *Apanteles flavipes*, Braconidae, *Chilo partellus*, mass rearing, entomophagous, laboratory study, environmental factor, relative humidity, Hymenoptera, India, Lepidoptera, parasitism, Pyralidae, host parasite relation, parasitism rate, temperature, ecology.

Varma, G.C.; Bindra, O.S. (1974) **Laboratory studies on multiparasitism in *Apanteles flavipes* (*cameron*) and *Apanteles chilonis munakata* (Braconidae: Hymenoptera).** *Indian journal of entomology.* 36(1): 34-37. ISSN: 0367-8288.
NAL Call Number: 420 IN23
Descriptors: *Apanteles flavipes*, Braconidae, interspecific competition, entomophagous, laboratory study, environmental factor, relative humidity, Hymenoptera, India, natural enemy introduction, multiparasitism, parasitism, temperature, ecology.

Lepidoptera

2004

Broderick, N.A.; Raffa, K.F.; Goodman, R.M; Handelsman, J. (2004) **Census of the bacterial community of the gypsy moth larval midgut by using culturing and culture-independent methods.** *Applied and Environmental Microbiology.* 70(1): 293-300. ISSN: 0099-2240.
NAL Call Number: 448.3 Ap5
Descriptors: ingestion and assimilation, ecology, Lepidoptera, *Lymantria dispar,* gypsy moth, polyphagous folivore, butterfly, moth, midgut, microbial analysis, DNA sequencing, rRNA sequencing, polymerase chain reaction, laboratory techniques, culturing techniques, insect diets, environmental biology.

DeChaine, E.G.; Martin, A.P. (2004) **Historic cycles of fragmentation and expansion in *Parnassius smintheus* (Papilionidae) inferred using mitochondrial DNA.** *Evolution.* 58(1): 113-127. ISSN: 0014-3820.
NAL Call Number: 443.8 Ev62
Descriptors: climatology, evolution and adaptation, paleobiology, population genetics, Lepidoptera, *Parnassius smintheus,* alpine butterfly, cytochrome oxidase I, mitochondrial DNA, archipelago model, nested clade analysis, laboratory techniques, climate oscillation and warming, cold glacial period, down-slope migration, ecosystem contraction and expansion, genetic drift and variation, high-elevation ecosystem, historic fragmentation cycle, molecular clock, natural selection, paleoclimatic events, phylogenetics, sky island refugia, evolution, environmental biology, boclimatology and biometeorology.

Gilbert, L.; Toivola, J.; Lehtomaki, E.; Donaldson, L.; Kapyla, P.; Vuento, M.; Oker-Blom, C. (2004) **Assembly of fluorescent chimeric virus-like particles of canine parvovirus in insect cells.** *Biochemical and Biophysical Research Communications.* 313(4): 878-887. ISSN: 0006-291X.
NAL Call Number: 442.8 B5236

Descriptors: biochemistry and molecular biophysics, infection, methods and techniques, DNA viruses, Lepidoptera, Baculovirus, Sf9 cell line, Canine parvovirus, enhanced green fluorescent protein, confocal imaging, laboratory techniques, comparative study, experimental morphology, physiology and pathology.

Martin, L.A.; Pullin, A.S. (2004) **Host-plant specialisation and habitat restriction in an endangered insect, *Lycaena dispar batavus* (Lepidoptera: Lycaenidae) I. Larval feeding and oviposition preferences.** *European Journal of Entomology.* 101(1): 51-56. ISSN: 1210-5759.
NAL Call Number: QL461 E9884
Descriptors: terrestrial ecology, environmental biology, *Lycaena dispar,* large copper butterfly, Lepidoptera, endangered species, larval feeding preferences, larval performance, oviposition preferences, *Rumex hydrolapathum,* Polygonaceae, laboratory experiment, laboratory techniques, fenland habitat, host-plant specialization, insect conservation, plant chemistry, specialized food plant requirements, specialized habitat requirements, wetland habitat loss.

Onyilagha, J.C.; Lazorko, J.; Gruber, M.Y.; Soroka, J.J.; Erlandson, M.A. (2004) **Effect of flavonoids on feeding preference and development of the crucifer pest *Mamestra configurata* (*walker*).** *Journal of Chemical Ecology.* 30(1): 109-124. ISSN: 0098-0331.
NAL Call Number: QD415.A1J6
Descriptors: terrestrial ecology, Cruciferae, Lepidoptera, *Brassica napus, Mamestra configurata*, 7,4'-dihydroxyflavone, dihydroquercetin, flavanones, flavanonols, flavonoids, isorhamnetin-3-sophoroside-7-glucoside, kaempferol-3,7-diglucoside, feeding deterrent bioassay, laboratory techniques, feeding preference, environmental biology.

Oura, M. (2004) **Insect factory. Mass production of useful proteins using silkworms.** *Kagaku to Seibutsu.* 42(2): 72-74. ISSN: 0453-073X.
Descriptors: *Bombyx mori,* silkworm, sericulture, animal protein, recombinant protein, useful material, mass production, production system, unmanned factory, nuclear polyhedrosis virus, vector, genetics, productivity enhancement, Lepidoptera, larva, growth stage, rearing management, insect and animal virus.

Schmitt, T.; Hewitt, G.M. (2004) **The genetic pattern of population threat and loss: A case study of butterflies.** *Molecular Ecology.* 13(1): 21-31. ISSN: 0962-1083.
NAL Call Number: QH540.M64
Descriptors: biogeography, population genetics, terrestrial ecology, Lepidoptera, *Erebia medusa*, *Pieris napi*, *Polyommatus coridon*, allozyme electrophoresis, laboratory techniques, biodiversity loss, fitness, genetic population structure, glacial refugia, phylogeographical patterns, environmental biology.

Schtickzelle, N.; Baguette, M. (2004) **Metapopulation viability analysis of the bog fritillary butterfly using RAMAS/GIS.** *Oikos.* 104(2): 277-290, ISSN: 0030-1299.
NAL Call Number: 410 OI4

Descriptors: conservation, mathematical and computational biology, population studies, terrestrial ecology, environmental sciences, Lepidoptera, *Proclossiana eunomia,* bog fritillary butterfly, RAMAS/GIS 3.0, metapopulation viability analysis, mathematical and computer techniques, population viability analysis, laboratory techniques, spatially structured metapopulation model, climatic variables, demographic parameters, density dependence, dispersal, fragmented landscapes, global warming, habitat fragmentation, habitat management, local population dynamics, metapopulation dynamics and persistence, natural habitat patches, patch dynamics, rustic herbivore grazing, environmental biology.

2001

Buckingham, G.R.; Bennett, C.A. (2001) **Life history and laboratory host range tests of *Parapoynx seminealis* (*walker*) (Crambidae: Nymphulinae) in Florida, U.S.A.** *Journal of the Lepidopterists' Society.* 55(3): 111-118. ISSN: 0024-0966.
NAL Call Number: 421 L554
Descriptors: pest assessment control and management, terrestrial ecology, environmental biology, Hydrocharitaceae, Lepidoptera, *Egeria densa*, *Hydrilla verticillata*, *Nymphoides aquatica*, Neuroptera, *Parapoynx seminealis*, biological control agent, host range, life history.

Tisdale, R.A.; Sappington, T.W. (2001) **Realized and potential fecundity, egg fertility, and longevity of laboratory-reared female beet armyworm (Lepidoptera : Noctuidae) under different adult diet regimes.** *Annals of the Entomological Society of America.* 94(3): 415-419. ISSN: 0013-8746.
NAL Call Number: 420 En82
Descriptors: fecundity, fertility, egg, longevity, female, diet, pest, laboratory study, *Spodoptera exigua*, population dynamics, environmental factor, Noctuidae, Lepidoptera.

2000

Miao, Y. (2000) **Studies on the light and water content of artificial diet for silkworm, *Bombyx mori*, rearing.** *Sericologia.* 40(3): 399-405. ISSN: 0250-3980. Notes: 5 ref.
Abstract: It was studied the effects of the light and water content of artificial diet rearing on the growth and development of silkworm, *Bombyx mori l.* The results showed: Treatment with 16h light and 8h dark in rearing period was suitable to the silkworm growth; 68-72% of water content in artificial diet is suitable.
Descriptors: *Bombyx mori*, silkworms, light regimes, feeds, moisture content, silkworm performance, Bombycidae, environmental control, Lepidoptera, lighting, useful insects.

Peng, Y.; Ohura, M. (2000) **Remote automated environmental control system for insect production.** *Applied Engineering in Agriculture.* 16(6): 715-721. ISSN: 0883-8542.
NAL Call Number: S671.A66
Descriptors: insect production facility, silkworm growth, temperature and humidity, remote control, E-mail server, natural ventilation, control algorithm.

Ziesmann, J.; Valterova, I.; Haberkorn, K.; Sanchez, M.G. de Brito; Kaissling, K.E. (2000) **Chemicals in laboratory room air stimulate olfactory neurons of female *Bombyx mori*.** *Chemical Senses.* 25(1): 31-37. ISSN: 0379-864X. Note: chemse.oupjournals.org/ URL: http://www.oup.co.uk
NAL Call Number: QP456.C5
Descriptors: chemicals, environmental effects, experimental laboratories, olfactory neuron perception and stimulation, chemicals in laboratory air, female *Bombyx mori*.

1999

Fantinou, A.A.; Tsitsipis, J.A. (1999) **Effect of larval density on development and diapause of *Sesamia nonagrioides* (*lef.*) (Lep., Noctuidae) under laboratory conditions.** *Journal of applied entomology.* 123(3): 187-190. ISSN: 0931-2048.
NAL Call Number: 421 Z36
Descriptors: population density, life cycle, diapause, larva, pupation, controlled environment study, *Sesamia nonagrioides*, Noctuidae, Lepidoptera.

Gao, J.; Li, T.; Deng, J.; Wu, X.; Song, C.; Wang, G.; Zhu, W.; Hong, C. (1999) **Effect of temperature and humidity on a laboratory population of *Ephestia elutella hubner*.** *Zoological Research.* 20(5): 368-371. ISSN: 0254-5853.
NAL Call Number: QL1.T85
Descriptors: stored products insect pests, life tables, biological development, reproduction, population dynamics, air temperature, relative humidity, environmental factors, longevity, survival, fertility, hatching, agricultural entomology, *Ephestia elutella*, Pyralidae, Lepidoptera, development and life cycle, wild insects, meteorology and climate.

Ma, J.; Chen, Y.; Xiao, S.; Mo, G. (1999) **Influence of temperature on the increase of laboratory population of *Spodoptera exigua*.** *Journal of Hunan Agricultural University.* 25(4): 308-311. Note: In Chinese.
NAL Call Number: S471 C62H852
Descriptors: life history, development, fecundity, environmental factors, temperature, survival, reproduction, mathematical models, agricultural entomology, *Spodoptera exigua*, Noctuidae, Lepidoptera, pests, pathogens and biogenic diseases of plants, mathematics and statistics.

Matheson, S.F.; Levine, R.B. (1999) **Steroid hormone enhancement of neurite outgrowth in identified insect motor neurons involves specific effects on growth cone form and function.** *Journal of Neurobiology.* 38(1): 27-45. ISSN: 0022-3034.
NAL Call Number: QP351 J55
Descriptors: growth cone, cytoskeleton, steroid hormone, metamorphosis, neurite outgrowth, ecdysone, cell culture, morphometry, microtubule associated protein, interference contrast microscopy, dendritic spine density, *Manduca sexta*, hippocampal neurons, time lapse, in vitro, sympathetic neurons, target, recognition, tobacco hornworm, Lepidoptera.

Peng, Y.; Ohura, M. (1999) **Development of measurement and control system of rearing**

environment for insect factory, 2: Temperature and humidity control of silkworm [*Bombyx mori*] rearing room. *Journal of the Japanese Society of Agricultural Machinery.* 61(4): 151-158. ISSN: 0285-2543. Notes: 9 figs., In Japanese.
NAL Call Number: 58.9 So1
Descriptors: silkworms, sericultural equipment, thermoregulation, humidity control, air conditioning, animal husbandry, equipment, environmental control, physiological functions and regulation, useful insects.

1998

Fantinou, A.A.; Tsitsipis, J.A.; Karandinos, M.G. (1998) **Diapause termination in *Sesamia nonagrioides* (Lepidoptera: Noctuidae) under laboratory and field conditions.** *Environmental entomology.* 27(1): 53-58. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: dormancy breaking, diapause, pest, cereal crop, photoperiod, temperature, overwintering, Greece, *Zea mays*, *Sesamia nonagrioides*, Europe, environmental factor, Gramineae, Monocotyledones, Angiospermae, Spermatophyta, Noctuidae, Lepidoptera.

Ohura, M.; Peng, Y. (1998) **[Construction of silkworm [*Bombyx mori*] rearing environment automatic control system by personal computer.]** *Journal of Sericultural Science of Japan.* 67(3): 231-236. ISSN: 0037-2455. Notes: 1 table; 9 fig., In Japanese.
NAL Call Number: 425.9 SE6
Descriptors: *Bombyx mori*, rearing techniques, mass rearing, environmental computer control systems, temperature, humidity, Bombycidae, Lepidoptera.

Peng, Y.; Ohura, M. (1998) **[Development of measurement and control system of rearing environment for insect factory, 1: Configuration of simulation system and fundamental examination.]** *Journal of the Japanese Society of Agricultural Machinery.* 60(3): 107-115. ISSN: 0285-2543. Notes: 2 tables; 10 fig.; 6 ref., In Japanese.
NAL Call Number: 58.9 So1
Descriptors: silkworms, environmental control, mass rearing, optimization methods, operations research, rearing techniques, *Bombyx mori*.

Shirai, Y. (1998) **Laboratory evaluation of flight ability of the oriental corn borer, *Ostrinia furnacalis* (Lepidoptera: Pyralidae).** *Bulletin of entomological research.* 88(3): 327-333. ISSN: 0007-4853.
NAL Call Number: 421 B87
Descriptors: pest, duration, flight, temperature, longevity, breeding success and mating, reproduction, *Ostrinia furnacalis*, environmental factor, Pyralidae, Lepidoptera.

Singh, G.P.; Mathur, V.B.; Kamble, C.K.; Datta, R.K. (1998) **Young age rearing of silkworm, *Bombyx mori l.*, a review.** *Sericologia.* 38(2): 199-228. ISSN: 0250-3980. Notes: 85 ref., 9 tables.
Descriptors: *Bombyx mori*, silkworms, young insects, rearing techniques, environmental temperature, relative humidity, feeding, nutritional requirements, leaves, Bombycidae, environmental factors, Lepidoptera, Moraceae.

Stan, G. (1998) **[Influence of temperature on growth, development and food consumption by larvae of *Mamestra brassicae l.* (Lepidoptera: Noctuidae) under laboratory conditions.]** *Studia Universitatis Babes Bolyai Biologia.* 43(1-2): 51-64. ISSN: 0039-3398. Note: In Romanian.
NAL Call Number: 442.9 C62
Descriptors: climatology, Lepidoptera, *Mamestra brassicae*, Noctuidae, larva, food consumption, biomass conversion, efficiency, temperature effects, physiology, ecology, developmental biology, embryology, morphogenesis.

Tshernyshev, W.B.; Danthanarayana, W. (1998) **Laboratory studies of flight activity in some noctuids (Lepidoptera: Noctuidae: Heliothinae). 2. Activity from day to day.** *Russian Entomological Journal.* 7(1/2): 96-100.
Descriptors: flight activity, moonlight effects, magnetism, atmospheric pressure, environmental factors, biology, behavior, *Australothis rubrescens*, *Helicoverpa armigera*, *Helicoverpa punctigera*, Noctuidae, Lepidoptera, plant pests.

Xie, L.; Jiang, M.; Zhang, X. (1998) **[Effect of temperature and humidity on laboratory population of *Helicoverpa assulta*.]** *Acta Entomologica Sinica.* 41(1): 61-69. ISSN: 0454-6296. Note: In Chinese.
NAL Call Number: 421 K96
Descriptors: Lepidoptera, *Helicoverpa assulta*, tobacco budworm, developmental duration, fecundity, survival rate, temperature and humidity effects, environmental biology, reproductive system, physiology, biochemistry.

1997

Papiewska, C.A. (1997) **[Differences in individual development and morphology within larval populations of *Pieris brassicae l.* (Lep., Pieridae) reared at different temperatures and photoperiods.]** *Novenyvedelem.* 33(3): 121-127. ISSN: 0133-0829. Notes: 5 Tables; 6 ill., In Hungarian.
NAL Call Number: Z5354 P2A34
Abstract: According to our observations on *Pieris brassicae l.* larvae reared in 1994 and 1995 in our laboratory, the ones kept at 23˚C and 25˚C and at 13:11 LD photoperiod went to 100 percent into diapause while the ones kept at 14:10 LD diapaused only to 50 percent. At the highest temperature level (28 degrees C) only 60 percent of larvae entered diapause at 13:11 LD and none of them at 14:10 LD photoperiod. At the longer light periods (15:9, 16:8, 17:7 LD) all larvae transformed into adults, without diapause. The various rearing temperatures and photoperiods resulted in differences of the head capsule measurements of larvae. Simultaneously to increasing temperature the widhts of head capsules decreased of all larval stages.
Descriptors: *Pieris brassicae*, larvae, temperature at 23˚C and 25˚C, photoperiodicity, diapause, Hungary, developmental stages, dormancy, environmental factors, Lepidoptera, light regimes.

Shukla, A.; Pathak, S.C.; Agrawal, R.K. (1997) **Effect of some plant odours in the breeding environment on fecundity and hatching of okra shoot and fruit borer, *Earias vittella fab.* under laboratory conditions.** *Crop Research (Hisar).* 13(1): 157-161. ISSN: 0970-

4884.
NAL Call Number: 80 H7892
Descriptors: biochemistry and molecular biophysics, okra plant pest, physiology, reproductive system, sense organs, sensory reception, Labiatae, Lepidoptera, Liliaceae, Meliaceae, Myrtaceae, Verbenaceae, garlic, neem, *Allium sativum*, *Azadirachta indica*, *Earias vittella*, *Eucalyptus rostrata*, *Lantana camara*, *Ocimum basilicum*, adult longevity, cotton pest, egg hatching and output, fecundity, fruit borer, hatching, plant odor, shoot borer, spotted bollworm, *Tulsi*, sense organs, developmental biology, embryology, morphogenesis.

1996

Grant, A.J.; Borroni, P.F.; O'Connell, R.J. (1996) **Different seasonal rearing conditions do not affect pheromone-sensitive receptor neurons of the adult cabbage looper, moth, *Trichoplusia ni*.** *Physiological Entomology.* 21(1): 59-63. Notes: 32 ref.
NAL Call Number: QL461.P5
Descriptors: temperature effects, photoperiodicity, tissues, *Trichoplusia ni*, environmental factors, sex pheromones, body parts, Lepidoptera, light regimes, nervous system, Noctuidae, North America, semiochemicals.

Magrini, E.A.; Neto, S.S.; Parra, J.R.; Botelho, P.S. (1996) **Effect of temperature on egg laying capacity and longevity of *Anticarsia gemmatalis hubner* (Lepidoptera: Noctuidae) under laboratory conditions.** *Revista de Agricultura (Piracicaba).* 71(1): 93-103. ISSN: 0034-7655.
NAL Call Number: 9.2 R324
Descriptors: temperature, oviposition, biology, environmental factors, plant pest, *Anticarsia gemmatalis*, Noctuidae, Lepidoptera, behavior.

Nishimura, A.; Fujieda, T.; Kuwabara, N. (1996) **[Effects of temperature in the fifth instar and cocooning frame on the cocoon quality and diapause property in the parent silkworms reared on artificual diet.]** *Bulletin of the Gunma Sericultural Experiment Station.* (2): 23-26. ISSN: 1341-2981. Notes: 2 tables, In Japanese.
Descriptors: *Bombyx mori*, environmental temperature effects, diapause, caterpillar feeding, Bombycidae, dormancy, environmental factors, Lepidoptera.

Tsenov, P.; Selskostopanska, A.S. (1996) **[The effect of some environmental factors during rearing of parent silkworms on the hatchability of daughter eggs.]** *Zhivotnov"dni Nauki , Animal Science.* 33(5): 70-73. ISSN: 0514-7441. Notes: 3 tables; 15 ref., In Bulgarian.
NAL Call Number: SF1.A56
Descriptors: *Bombyx mori*, parents, temperature, silkworm feeding, daughter eggs, hatching, ancestry, developmental stages, Lepidoptera, physiological functions, progeny, sexual reproduction, insect husbandry rearing production, physiology.

1995

Atachi, P.; Ahounou, M. (1995) **Experimental study of the biological potential of *Maruca testulalis* (*geyer*) (Lepidoptera: Pyralidae) on some food substrata under laboratory conditions.** *Bulletin de la Societe Zoologique de France Evolution et Zoologie.* 120(1): 29-45. ISSN: 0037-962X.
NAL Call Number: 410.9 P214B
Descriptors: aging, ecology, genetics, physiology, reproductive system, Lepidoptera, *Maruca testulalis*, life history, longevity, mortality, sex ratio, cytogenetics, sex differences, environmental biology, pathology, necrosis, biochemistry, gerontology, diets.

Brakefield, P.M.; Mazzotta, V. (1995) **Matching field and laboratory environments - effects of neglecting daily temperature- variation on insect reaction norms.** *Journal of Evolutionary Biology.* 8(5): 559-573. ISSN: 1010-061X.
NAL Call Number: QH359 J68
Descriptors: reaction norm, phenotypic plasticity, life history, thermoperiod, wing pattern of butterfly, evolutionary significance, Lepidoptera, growth, patterns of selection, genetic assimilation, reproductive strategies, life-history evolution, ecological costs, rapid senescence, maturation in insects.

Ermakova, N.I.; Efimov, V.M. (1995) **Cyclical changes in the state of a laboratory population of the meadow moth (*Loxostege sticticalis l.*).** *Zhurnal Obshchei Biologii.* 56(3): 380-390. ISSN: 0044-4596.
NAL Call Number: 442.8 Z6
Descriptors: ecology, microbiology, physiology, reproductive system, Lepidoptera, viruses, *Loxostege sticticalis*, competition, population density and dynamics, viral contamination, environmental biology, biochemistry.

Fedosov, S.A. (1995) **Diurnal activity rhythm of the fall webworm, *Hyphantria cunea* (Lepidoptera, Arctiidae) in nature and in the laboratory.** *Entomological Review.* 74(5): 77-84. ISSN: 0013-8738. Note: English Translation of Entomologicheskoye Obozreniye.
NAL Call Number: 421 R322Ae
Descriptors: biosynchronization, ecology, physiology, reproductive system, Lepidoptera, *Hyphantria cunea*, adult emergence, oviposition, circadian rhythms and other periodic cycles, environmental biology, biochemistry, developmental biology, embryology, morphogenesis, laboratory and field comparisons.

Froehlich, P.A. (1995) *Engineering control observations and recommendations for insect rearing facilities at pink boll worm rearing facility, U.S. Department of Agriculture (USDA),Plant Protection and Quarantine Programs (PPQ), Animal and Plant Health Inspection Service (APHIS), Phoenix, Arizona. Animal and Plant Health Inspection Service, Edinburg, TX. Report Number: ECTB-010-01A* 30 Jan 1995, 30 pgs., Announcement: USGRDR0311
Abstract: In early 1993, the Engineering Control Technology Branch of the Division of Physical Sciences and Engineering was asked to assist in an Occupational Asthma

Identification project being carried out by the Clinical Investigations Branch of the Division of Respiratory Disease Studies (DRDS) by evaluating engineering controls used in insect rearing facilities. This was to be done while assisting Patrick Hintz, Environmental Investigations Branch, DRDS with an industrial hygiene evaluation of three insect rearing facilities operated by the Animal and Plant Inspection Service, Plant Protection and Quarantine Programs, U.S. Department of Agriculture. Observations were made at the Pink Boll Work Rearing Facility in Phoenix, Arizona, August 22-26, 1993; the Mexican Fruit Fly Rearing Facility in Edinburg, Texas, August 28-30, 1993; and the Gypsy Moth Rearing Group at Otis Air National Guard Base, Massachusetts, November 1-4, 1993.
Descriptors: engineering controls, occupational safety and health of workers, insect rearing facilities, industrial hygiene, recommendations, asthma, respiratory diseases, environmental surveys, facilities, Mexican fruit flies, Gypsy moths, Pink boll worms, occpational asthma identification, NTISHEWOSH, Lepidoptera, US Dept. Of Agriculture.

Keena, M.A.; Odell, T.M.; Tanner, J.A. (1995) **Phenotypic response of two successive gypsy moth (Lepidoptera: Lymantriidae) generations to environment and diet in the laboratory.** *Annals of the Entomological Society of America.* 88(5): 680-689. ISSN: 0013-8746.
NAL Call Number: 420 EN82
Descriptors: development, genetics, nutrition, pathology, physiology, Lepidoptera, *Lymantria dispar*, abnormal performance syndrome, development, larvae, cytogenetics, diets, nutritional status and methods, developmental biology, embryology, morphogenesis.

Kirby, M.L.; Ottea, J.A. (1995) **Multiple mechanisms for enhancement of glutathione-S-transferase activities in *Spodoptera frugiperda* (Lepidoptera, Noctuidae).** *Insect Biochemistry and Molecular Biology.* 25(3): 347-353. ISSN: 0965-1748.
NAL Call Number: QL495.A1I57
Descriptors: glutathione-s-transferase, 8-methoxypsoralen, xanthotoxin, pentamethylbenzene, enzyme induction, aryl-hydrocarbon hydroxylase, YA subunit gene, tetrachlorvinphos resistant strain, antioxidant responsive element, fall armyworm Lepidoptera, house fly, *Drosophila melanogaster*, insecticide resistance, phytophagous insects, inducible expression, plant pests.

Leyva, K.J.; Clancy, K.M.; Price, P.W. (1995) **Performance of wild versus laboratory populations of western spruce budworm (Lepidoptera: Tortricidae) feeding on douglas-fir foliage.** *Environmental Entomology.* 24(1): 80-87. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: ecology, economic entomology, forestry, pathology, physiology, Lepidoptera, *Choristoneura occidentalis*, *Pseudotsuga menziesii*, crop industry significance, population, environmental biology, necrosis, comparative study.

Mankin, R.W.; D.W. Hagstrum (1995) **Three-dimensional orientation of male *Cadra cautella* (Lepidoptera: Pyralidae) flying to calling females in a windless environment.** *Environmental Entomology.* 24(6): 1616-1626. ISSN: 0046-225X.

NAL Call Number: QL461.E532

Abstract: A male *Cadra cautella* (*walker*) flying in a windless environment first reacts behaviorally to the sex pheromone plume of a calling female from a distance of approximately 40 cm. Its angular velocity (turning rate in degrees per second) increases and, if it approaches within approximately 20 cm, its velocity decreases gradually until it lands near the female. The orientation pattern differs from orientation in wind primarily in the fraction of turns with net movement away from the female, initially approximately 0.5. This fraction decreases to approximately 0.2 if the male approaches within approximately 10 cm. Previously developed computer models suggest that such behavior is less efficient for finding a pheromone source than pheromone-stimulated optomotor anemotaxis but more efficient than random searching. Thus, it can be expected that pheromone traps are less effective at sampling remote populations of insects in a warehouse than in a field, but are helpful in pinpointing nearby infestations.

Descriptors: *Ephestia cautella*, males, flight, orientation, female sex pheromones, male searching behavior, wind, taxis, comparisons, communication between Lepidopterans.

Sekharappa, B.M.; Muniraju, E.; Gururaj, C.S. (1995) **Use of an isolation chamber for rearing young age (chawki) silkworms in the tropics.** *Sericologia.* 35(3): 525-538. ISSN: 0250-3980. Notes: 14 ref., In English and French.

Descriptors: silkworms, *Bombyx mori*, tropical zones, animal husbandry equipment, silkworm housing, heating, humidity, larvae, biological development, performance, veterinary hygiene, developmental stages, Bombycidae, chemicophysical properties, environmental control, equipment, Lepidoptera, useful insects.

1994

Barker, J.F.; Enz, J.W. (1994) **Development of laboratory reared banded sunflower moth, *Cochylis hospes walsingham* (Lepidoptera: Cochylidae), in relation to temperature.** *Journal of the Kansas Entomological Society.* 66(4): 420-426. ISSN: 0022-8567.

NAL Call Number: 420 K13

Descriptors: agronomy, biosynchronization, climatology, economic entomology, mathematical biology, computational biology, models and simulations, morphology, pathology, physiology, Lepidoptera, *Cochylis hospes*, degree days, diapause, head capsule size, humidity, larva, mortality, predictive model, pupa, seasonality, statistical methods, circadian rhythms and other periodic cycles, ecology, environmental biology, bioclimatology and biometeorology, biophysics, biocybernetics, external effects-temperature as a primary variable, necrosis, developmental biology, embryology, morphogenesis, comparative and experimental morphology, sunflower pest.

Kim, J.U. (1994) **Study on technical system of rearing Japanese oak silkworm, *Antheraea Yamamai cuerin-meneville.*** *Korean Journal of Sericultural Science.* 36(2): 130-137. ISSN: 0440-2332. Notes: 1 illus.; 6 tables; 25 ref.

NAL Call Number: SF553 K6H3

Descriptors: *Antheraea*, rearing techniques, environmental factors, temperature, humidity, lighting, feeds, chemicophysical properties, Lepidoptera, Saturniidae, artificial rearing system.

Pons, S.; Eizaguirre, M.; Sarasua, M.J.; Avilla, J. (1994) **Influencia del photoperiod en la inducción del diapause del pomonella de *Cydia* (Lepidoptera: Tortricidae) en condiciones del laboratorio y del campo. [Influence of photoperiod on diapause induction of *Cydia pomonella* (Lepidoptera: Tortricidae) in laboratory and field conditions.]** *Investigacion Agraria. Produccion y Proteccion Vegetales, Dic.* 9(3): 477-492. ISSN: 0213-5000. Notes: 3 tab., 5 fig.; 23 ref., In Spanish.
NAL Call Number: SB29.S7 I59
Descriptors: *Cydia pomonella*, biological development, developmental stages, diapause, photoperiodicity, field and laboratory experimentation, Spain, dormancy, environmental factors, Lepidoptera, light regimes, methods, Tortricidae, trial methods.

Popescu, M.; Ciovica, C.; Paraschivescu, M. (1994) **[Study of microclimate for silkworm rearing houses.]** *Medicina veterinara si cresterea animalelor.* 4-5: 5-8. ISSN: 1220-8507. Notes: 2 tables; 5 ref., In Romanian.
NAL Call Number: SF1 P735
Abstract: The paper presents the results of several light intensity determinations, of carbon dioxide concentrations and of draft speed in a climatised IFET type rearing house. Light intensity which was unevenly distributed on the rearing area showed high variations between 3-800 lux. The carbon dioxide build-up determined in the house populated at the highest capacity increased at the same time with larvae aging without exceeding the highest admitted level of 0,5 percent for the silk worm. The draft speed, depending on the relative humidity and on the airing system had average values up to 0,280 m/s.
Descriptors: silkworms, insect housing, microclimate, environmental factors, climate, useful insects, light lux levels, CO_2 levels, ventilation.

Sanshikonchunogiken (1994) **[News of the sericultural and insect laboratory.]** *Sanshi Konchuken Nyusu.* (24): 4. ISSN: 0915-2679. Note: Journal Number: J1028AAU, Sponsor: National Institute of sericultural and Entomological Science Ministry of Agriculture, Forestry and Fisheries, In Japanese.
NAL Call Number: SF542.75.J3S36
Descriptors: sericulture, *Morus alba*, plant breeding, silkworm, ultraviolet irradiation, leaf analysis, antifeedant, environmental pollution, rearing management, Moraceae, Phanerogamae, breeding, genetics, larvae, growth stage, photoirradiation, electromagnetic irradiation, biological sample analysis, defensive substance, allomone, bioactive factor, insect rearing.

Sharan, S.K.; Singh, M.K.; Ojha, N.G.; Sinha, S.S. (1994) **Regulation of voltinism in *Antheraea mylitta* by manipulation of rearing period of larval stages.** *International Journal of Wild Silkmoth and Silk.* 1(2): 191-194. ISSN: 1340-4725. Notes: 2 tables; 7 ref.
Descriptors: *Antheraea mylitta*, dormancy, larvae, environmental factors, silkworms, life cycle, developmental stages, Lepidoptera, Saturniidae, useful insects.

Wang, M.Y.; W.E. Bentley (1994) **Continuous insect cell (Sf-9) culture with aeration through sparging.** *Applied microbiology and biotechnology.* 41(3): 317-323. ISSN: 0175-7598.

NAL Call Number: QR1.E9
Abstract: The continuous growth of *Spodoptera frugiperda* Sf-9 cells in a 250-ml blown-glass jacketed spinner flask under a direct air sparging environment was investigated. Even at 220 ml working volume (about 90% of total volume), this spinner flask provided good mixing and oxygenation as demonstrated by a higher cell density compared with fermentor cultures. This eliminates a common limitation of the traditional spinner flask, namely much lower cell density at high working volume. Furthermore, this spinner flask has been run with Sf-9 cell culture at five different dilution rates and two different air sparging rates at steady state, demonstrating its utility in research applications where cell size, metabolic activity and environmental conditions can be constantly maintained. In addition to demonstrating the utility of the reactor, three novel points are made in this report. First, cell density in continuous cultures is increased significantly due to a high agitation rate and, especially, air sparging rate, which is seldom used in animal cell or insect cell culture. Second, there is no apparent difference in the specific death rate at two different sparging rates (0.0093 vvm and 0.0125 vvm). Finally, we have maintained Sf-9 cells for more than 4 months in a continuous culture using a serum-free medium without loss of recombinant protein expression in infected cells.
Descriptors: *Spodoptera frugiperda* (sf-9), insect cell lines, cell culture, agitation, aeration, processing, density, growth rate, metabolism, viability, genetic vectors, protein synthesis, serum-free medium, oxygenation.

1993

Boots, M.; Begon, M. (1993) **Trade-offs with resistance to a granulosis virus in the Indian meal moth, examined a laboratory evolution experiment.** *Functional Ecology.* 7(5): 528-534. ISSN: 0269-8463.
NAL Call Number: QH540 F85
Descriptors: development, ecology, economic entomology, evolution and adaptation, genetics, infection, microbiology, pathology, pest assessment control and management, reproductive system, Lepidoptera, *Plodia interpunctella*, developmental time, egg viability, fitness costs, genotype, life history traits, microbial agents, microevolutionary selection, pest species, pupal weight, evolution, cytogenetics, environmental biology, developmental biology, embryology, morphogenesis, host viruses, medical and clinical microbiology, virology, comparative and experimental morphology, physiology.

Han, E.N.; Bauce, E. (1993) **Physiological changes and cold hardiness of spruce budworm larvae, *Choristoneura fumiferana* (*clem.*), during pre-diapause and diapause development under laboratory conditions.** *Canadian Entomologist.* 125(6): 1043-1053. ISSN: 0008-347X.
NAL Call Number: 421 C16
Descriptors: biochemistry and molecular biophysics, climatology, ecology, economic entomology, physiology, Lepidoptera, *Choristoneura fumiferana*, biochemical metabolite, overwintering, supercooling, water content, bioclimatology and biometeorology, environmental biology, physiological water studies, temperature: its measurement, effects and regulation, thermoadaptation, developmental biology, embryology, morphogenesis, comparative and experimental morphology, pathology.

Hughes, D.S.; R.D. Possee; L.A. King (1993) **Activation and detection a latent baculovirus resembling *Mamestra brassicae* nuclear polyhedrosis virus in *M. brassicae* insects.** *Virology.* 194(2): 608-615. ISSN: 0042-6822.
NAL Call Number: 448.8 V81
Abstract: A laboratory culture of *Mamestra brassicae* insects (MbLC) has been found to harbor a latent baculovirus infection. The latent virus was activated by feeding the *M. brassicae* larvae with either the closely related *Panolis flammea* nuclear polyhedrosis virus (NPV), or the distantly related *Autographa californica* NPV. Restriction fragment profiles of the activated virus DNA showed that it is very closely related, if not identical, to *M. brassicae* NPV. Polymerase chain reaction amplification of polyhedrin gene sequences demonstrated that the latent virus was present throughout the life cycle of the insect; eggs, larvae, pupae, and adults. We failed to detect the presence of a latent virus in a second culture of *M. brassicae* insects, obtained from the environment and only recently adapted to growth in laboratory conditions, and thus these insects acted as an effective negative control in all the PCR and activation experiments. Using PCR analysis of DNA isolated from dissected tissues of fourth instar MbLC larvae, latent virus sequences were only detected in the fat body. Cell lines established from the isolated MbLC fat body tissue were also shown to harbor the latent virus sequences and should prove useful in further studies to elucidate the mechanisms of latency and virus activation.
Descriptors: *Mamestra brassicae*, Lepidoptera, larvae, developmental stages, nuclear polyhedrosis viruses, latent infections, DNA, nucleotide sequences, mode of action, body fat, cell lines.

Ingalls, V. (1993) **Startle and habituation responses of blue jays (*Cyanocitta cristata*) in a laboratory simulation of anti-predator defenses of *Catocala* moths (Lepidoptera: Noctuidae).** *Behavior* 126(1-2): 77-96. ISSN: 0005-7959.
NAL Call Number: 410 B393
Descriptors: ecology, physiology, sense organs, sensory reception, Lepidoptera, *Catocala*, *Cyanocitta cristata*, visual characteristics, behavioral biology, environmental biology, sense organs, associated structures and functions, physiology and biochemistry, comparative and experimental morphology, pathology.

Kami, K. (1993) **Diapause termination in *Busseola fusca* (Lepidoptera: Noctuidae) in the laboratory.** *Annals of the Entomological Society of America.* 86(3): 273-277. ISSN: 0013-8746.
NAL Call Number: 420 En82
Descriptors: diapause, temperature, photoperiod, diet, water, laboratory study, pest, cereal crop, feeding, corn *Zea mays*, *Busseola fusca*, environmental factor.

Kfir, R. (1993) **Diapause termination in the spotted stem borer, *Chilo partellus* (Lepidoptera: Pyralidae) in the laboratory.** *Annals of Applied Biology.* 123(1): 1-7.
Notes: 32 ref.
NAL Call Number: 442.8 AN72
Descriptors: stem eating insects, temperature, photoperiodicity, diet, *Chilo partellus*, biology, diapause, dormancy, environmental factors, light regimes, lighting, noxious insects, pests.

Monastyrskii, A.L.; Kotlobai, A.A. (1993) **Some biological characteristics of *Sericinus telamon* (*papilionoidea*) and its rearing in laboratory.** *Zoologicheskii Zhurnal.* 72(5): 142-146. ISSN: 0044-5134.
NAL Call Number: 410 R92
Descriptors: biosynchronization, ecology, endocrine system, chemical coordination and homeostasis, morphology, nutrition, physiology, Aristolochiaceae, Lepidoptera, *Aristolochia clematitis*, *Aristolochia contorta*, *Sericinus telamon*, caterpillar longevity, diapause, egg emergence, ethology, fecundity, morphology, predation, pupation, rare species, behavioral biology, circadian rhythms and other periodic cycles, environmental biology, anatomy and histology, nutritional status and methods, reproductive system, biochemistry, endocrine system, neuroendocrinology, developmental biology, embryology, morphogenesis.

Onyango, F.O.; Ochieng'-Odero, J.P. (1993) **Laboratory rearing of the legume pod borer, *Maruca testulalis geyer* (Lepidoptera: Pyralidae) on a semi-synthetic diet.** *Insect Science and its Application.* 14(5-6): 719-722. ISSN: 0191-9040.
NAL Call Number: QL461.I57
Descriptors: ecology, economic entomology, horticulture, nutrition, physiology, reproductive system, cowpea, soybean, *Maruca testulalis*, fecundity, fertility, environmental biology, nutrition general dietary studies, biochemistry, developmental biology, embryology, morphogenesis, comparative and experimental morphology, nutritional status and methods.

Rami, K. (1993) **Diapause termination in the spotted stem borer, *Chilo partellus* (Lepidoptera: Pyralidae) in the laboratory.** *Annals of applied biology.* 123(1): 1-7. ISSN: 0003-4746.
NAL Call Number: 442.8 An72
Descriptors: laboratory study, photoperiod, temperature, water, life cycle, diet, pupation, diapause, *Chilo partellus*, pest, environmental factors.

1992

Allotey, J.; Goswami, L. (1992) **Competition between the phycitid moths *Plodia interpunctella* (*hubn.*) and *Ephestia cautella* (*wlk.*) in groundnuts and on a laboratory diet.** *Insect Science and its Application.* 13(5): 719-723. ISSN: 0191-9040.
NAL Call Number: QL461.I57
Descriptors: agronomy, population studies, ecology, economic entomology, foods, physiology, Juglandaceae, Leguminosae, Lepidoptera, Rosaceae, Palmae, Moraceae, *Cadra cautella*, control system planning, monitoring system, environmental biology, food technology, comparative and experimental morphology, nutrition.

Armes, N.J.; Bond, G.S.; Cooter, R.J. (1992) **The laboratory culture and development of *Helicoverpa armigera*.** *Bulletin - Natural Resources Institute (United Kingdom)* (57). ISSN: 0952-8245. Notes: 44 ref.
Descriptors: laboratory experimentation, diet, environmental factors, *Helicoverpa armigera*, rearing techniques, pathogens, Lepidoptera, Noctuidae, noxious insect pests.

Barker, J.F. (1992) **Diapause in laboratory reared banded sunflower moths, *Cochylis hospes walsingham* (Lepidoptera: Cochylidae), in relation to temperature and photoperiod.** *Journal of the Kansas Entomological Society.* 65(4): 431-434. ISSN: 0022-8567.
NAL Call Number: 420 K13
Descriptors: biosynchronization, ecology, physiology, *Cochylis hospes*, light, photoperiod, temperature, circadian rhythms, environmental biology, light and darkness, temperature effects, developmental biology, embryology, morphogenesis.

Gu, H.; Danthanarayana, W. (1992) **Influence of larval rearing conditions on the body size and flight capacity of *Epiphyas postvittana* [light brown apple] moths.** *Australian Journal of Zoology.* 40(6): 573-581. ISSN: 0004-959X. Notes: 2 tables, 7 fig., 27 ref.
NAL Call Number: 410 Au73
Abstract: Effects of rearing conditions of larvae on the body weight and flight duration of the light brown apple moth, *Epiphyas postvittana* (*walker*), were evaluated in the laboratory. The body weight of both male and female moths at emergence decreased with increasing temperature from 15 to 28 deg C during larval stages; in contrast, flight duration increased with rising temperature. There was no effect of larval density on flight duration, although the body weight of moths decreased as density increased. Variation in water content of artificial diet showed a significant influence on flight duration of female moths, but not on body weight in either sex. Flight duration was different only for females when their larvae were reared on young leaves of four host plants. Female moths from larvae on *Rumex crispus* and *Plantago lanceolata* flew for significantly longer periods than those from larvae on Trifolium repens and Pyrus malus. Larvae fed on young leaves yielded adults that flew for longer periods than those fed on senescent leaves. Inconsistency in relationships between body weight and flight duration of moths with respect to influences of different environmental factors during the larval stages indicates that flight capacity is unlikely to be influenced by body size in this species.
Descriptors: *Epiphyas postvittana*, larvae, weight, environmental factors, locomotion, wings, developmental stages, morphology, body regions, Lepidoptera, limbs, movement, physiological functions, Tortricidae.

Kobayashi, H.; Saitoh, T.; Yomoda, M. (1992) **[Establishment of use and development of rational rearing house in collective mulberry field, 3: Studies of rearing condition and care during mounting in slidehouse.]** *Gunma Journal of Agricultural Research Series B. Sericulture.* (9): 15-18. ISSN: 0910-4127. Notes: 8 tables; 2 fig., In Japanese.
Descriptors: *Bombyx mori*, sericultural equipment, *Morus*, environmental factors, insect husbandry equipment, Bombycidae, Lepidoptera, Moraceae.

Singh, A.K.; Rembold, H. (1992) **Maintenance of the cotton bollworm, *Heliothis armigera huebner* (Lepidoptera: Noctuidae) in laboratory culture: II. Determination of larval instars, their growth and modulation of development.** *Insect Science and its Application.* 13(3): 327-331. ISSN: 0191-9040.
NAL Call Number: QL461.I57
Descriptors: agronomy, insect development, ecology, economic entomology, physiology, Lepidoptera, Malvaceae, *Heliothis armigera*, head capsule, temperature tolerance, environmental biology, temperature effects and regulation, thermoadaptation, developmental biology, embryology, methods, head.

Varjas, L.; Kulcsar, P.; Fekete, J.; Bihatsi Karsai, E.; Lelik, L.; Mauchamp, B.; Couillaud, F.; Baehr, J.C. (1992) **JH titres measured by GC-MS, in the hemolymph of *Mamestra oleracea* larvae reared under different photoperiodic conditions.** *Insect juvenile hormone research. Fundamental and applied approaches. Chemistry, biochemistry and mode of action.* : 45-50. INRA , Paris (France). ISBN: 2-7380-0428-8.
Descriptors: *Mamestra*, insect pests, larvae, juvenile, hormones, haemolymph, photoperiodicity, gas chromatography, mass spectrometry, analytical methods, developmental stages, insect morphology, body fluids, chromatography, environmental factors, hormones, Lepidoptera, light regimes, Noctuidae, sesquiterpenoids, spectrometry, terpenoids.

1991

Jimenez-Velasquez, J.; Murgueitio, C. (1991) **Egg production characterization of *Sitotroga cerealella olivier* (Lep. Gelechiidae) under laboratory condition in Palmira, Colombia.** *Les Colloques de l'I.N.R.A.* (56): 145-146. ISSN: 0293-1915.
NAL Call Number: S539.7 C6
Descriptors: mass rearing, parasite, mass production, egg, host, temperature, humidity, Colombia, pest, environmental factor, entomophagous, *Oophagous*, *Sitotroga cerealella*, Lepidoptera, Trichogrammatidae, Chalcidoidea, Hymenoptera.

Tessier, D.C.; D.Y. Thomas; H.E. Kouri; F. Laliberte; T. Vernet (1991) **Enhanced secretion from insect cells of a foreign protein fused to the honeybee melittin signal peptide.** *Gene.* 98(2): 177-183. ISSN: 0378-1119.
NAL Call Number: QH442.A1G4
Abstract: The baculovirus/insect cell system has been remarkably successful in yielding high levels of synthesis of many proteins which have been difficult to synthesize in other host/vector systems. The system is also capable of secreting heterologous proteins, but with generally low efficiency. We have increased the efficiency of secretion of the system by using signal peptides of insect origin to direct the secretion of a foreign protein. The precursor of the plant cysteine protease papain (propapain) has been used as a report enzyme to compare secretion efficiency. Insect cells infected with a baculovirus recombined with the gene encoding propapain fused to the sequence encoding the honeybee melittin signal peptide secreted over five times more papain precursor than the wild-type prepropapain which used the plant signal peptide. Based on these results, we have assembled pVT-Bac, an *Autographa californica* nuclear polyhedrosis virus transfer vector that may enhance secretion of other foreign proteins from insect cells. The vector incorporates a number of features: phage f1 ori to facilitate site-directed mutagenesis, the strong polyhedrin promoter upstream from the melittin signal peptide-encoding sequence, and eight unique restriction sites to facilitate fusion of heterologous genes.
Descriptors: *Apis mellifera*, *Spodoptera frugiperda*, nuclear polyhedrosis viruses, vectors, recombinant DNA, melittin, peptides, papain, enzyme precursors, reporter genes, gene splicing, gene expression, protein secretion, cell lines and culture, Lepidoptera.

1990

Choe, K.J.; Lee, D.H.; Park, K.K. (1990) **[Study on heating load characteristics and thermal curtain effects for simple silkworm rearing houses, 1; Heating load coefficient and maximum heating load.]** *Journal of the Korean Society for Agricultural Machinery.* 15(4): 346-354. ISSN: 1010-4542. Notes: 7 illus; 3 tables; 8 ref, In Korean.
NAL Call Number: S671 H28
Descriptors: silkworms, sericulture, sericultural equipment, temperature, heating, insect husbandry equipment, insect production, environmental control, useful insects, mass rearing facilities.

Clare, G.K.; Pritam, S. (1990) **Use of day-degree estimates for rearing management of *Ctenopseustis obliquana* (Lepidoptera: Tortricidae) in the laboratory.** *New Zealand Journal of Zoology.* 17(4): 567-575. ISSN: 0301-4223.
NAL Call Number: QL1 A1N4
Descriptors: heat, reproduction, temperature effects, environmental impact, rearing techniques, noxious insects, pests, physiological functions, temperature, heat sums, *Ctenopseustis obliquana.*

Clare, G.K.; Pritam, S. (1990) **Variation in the number of larval instars of the brownheaded leafroller, *Ctenopseutis obliquana* (Lepidoptera :Tortricidae) at constant laboratory temperatures.** *New Zealand Journal of Zoology.* 17(1): 141-146. ISSN: 0301-4223.
NAL Call Number: QL1 A1N4
Descriptors: larva, life history, environmental factors, photoperiod, temperature effects, development.

He, S.; Xia, L. (1990) **[Breeding of the silkworm varieties "57A. 57B, 24.46" and their hybrids for both spring and autumn rearing.]** *Acta Sericologica Sinica.* 16(1): 15-20. ISSN: 0257-4799. Notes: 5 tables, 2 ref., In Chinese.
NAL Call Number: SF553 C6T73
Descriptors: *Bombyx mori*, genetic ancestry, crossbreeding, selection, silk quality and yields, environmental factors, hybrids, silkworm fibers, Bombycidae, breeding methods, Lepidoptera, processed insect products, progeny.

Jimenez-Velasquez, J.; Murgueitio, C. (1990) **Egg production characterization of *Sitotroga cerealella olivier* (Lep. Gelechiidae) under laboratory condition in Palmira, Colombia.** *Les Colloques de l'I.N.R.A.* (56): 145-456. ISSN: 0293-1915. ISBN: 2-7380-0323-0. Notes: International Symposium: *Trichogramma* and other egg parasitoids. San Antonio (USA) , 23-27 Sep 1990, INRA , Paris (France), 1991.
NAL Call Number: S539.7 C6
Descriptors: mass rearing, *Sitotroga cerealella*, hosts, *Trichogramma*, biological control, ova production, laboratory experiments, environmental temperature, relative humidity, biological competition, biological control organisms, cells, chemicophysical properties, environmental factors, humidity, Hymenoptera, Lepidoptera, parasitism, rearing techniques, Colombia.

Li, W.; Peng, B.; Dong, X. (1990) **[Studies on causal account for dead pupae in late stage of**

original silkworm egg rearing and its control I. Types of dead pupae, its causes and incidence regulation.] *Guangdong Sericultural Newsletter.* (2): 31-40. Notes: 2 ill., 8 tables, In Chinese.
Descriptors: silkworm production, breeding stock, pupae, death, Guangdong, insect pupae diseases, epidemics, disease control, environmental factors, developmental stages, epidemiology, useful insects, China.

Mahla, J.C.; Chaudhary, J.P. (1990) **Biometrical evaluation of sugarcane shoot borer (*Chilo infuscatellus snellen*) at fluctuating laboratory and constant temperatures.** *Crop Research (Hisar).* 3(1): 79-83. ISSN: 0970-4884.
NAL Call Number: 80 H7892
Descriptors: pests, temperature effects, reproduction, sugarcane, biology, environmental factors, agricultural entomology, Lepidoptera, Pyralidae, *Chilo infuscatellus*, Saccharum, Pyralidae, *Cyperales*.

Takayama, H.; Meguro, Y.; Ota, T. (1990) **[Rearing results on rearing bed with simple warming function at early winter rearing.]** *Bulletin of the Fukushima Sericultural Experiment Station.* (24): 17-23. ISSN: 0385-3365. Notes: 10 tables; 3 fig., In Japanese.
Descriptors: *Bombyx mori*, sericultural equipment, heating, sericulture, winter, insect husbandry equipment, insect production, Bombycidae, environmental control, seasonal effects.

1989

Bell, C.H. (1989) **Influence of natural and laboratory rearing conditions on the requirements for diapause in different breeding lines of the warehouse moth *Ephestia elutella* (*hubner*).** *Journal of Insect Physiology.* 35(2): 137-141. ISSN: 0022-1910.
NAL Call Number: 421 J825
Descriptors: stored products pests, environmental factors, temperature, photoperiod, survival, physiology, diapause, grain, Lepidoptera, Pyralidae, *Ephestia elutella*, biochemistry, biodeterioration, storage problems.

David, P.J.; Horsburgh, R.L.; Holtzman, G.I. (1989) **Development of *Platynota flavedana* and *P. idaeusalis* (Lepidoptera: Tortricidae) at constant temperatures in the laboratory.** *Environmental Entomology.* 18(1): 15-18. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: development, temperature, heat sums, pests, apples, biology, environmental factors, techniques, agricultural entomology, *Platynota flavedana*, *Platynota idaeusalis*, Malus, Rosaceae, techniques and methodology, insect rearing.

Muggleston, S.J. (1989) **Rearing and the effects of photoperiod and temperature on diapause in *Stathmopoda aposema* (Lepidoptera: Oecophoridae: Stathmopodinae).** *New Zealand Journal of Zoology.* 16(2): 199-204. ISSN: 0301-4223. Notes: 13 ref.
NAL Call Number: QL1 A1N4
Descriptors: diet, photoperiodicity, diapause, New Zealand, Actinidiaceae, developmental stages, dormancy, environmental factors, Lepidoptera, light regimes,

lighting, noxious insects, Oceania, pests.

Shen, W.; Hamano, K.; Mukaiyama, F. (1989) **[Effect of environmental temperature on the body temperature and respiratory intensity of silkworm *Bombyx mori* reared on artificial diet.]** *Acta Entomologica Sinica.* 32(1): 12-16. ISSN: 0454-6296. Notes: 6 ill., 9 ref., In Chinese.
NAL Call Number: 421 K96
Descriptors: silkworms, larvae, body temperature, respiration, feeds, feeding, developmental stages, Lepidoptera, nutrition, physiological functions, temperature, useful insects, zootechny.

1988

Beach, R.M.; Todd, J.W. (1988) **Development, reproduction, and longevity of *Autographa biloba* (Lepidoptera: Noctuidae), with observations on laboratory adaptation.** *Annals of the Entomological Society of America.* 81(6): 943-949. ISSN: 0013-8746.
NAL Call Number: 420 En82
Descriptors: fecundity, longevity, temperature, developmental stage, pest, laboratory study, artificial medium, environmental factor, Noctuidae, Lepidoptera.

Cappellozza, L. (1988) **Il baco da seta. Tecniche per inizio di un gelso bianco rinnovato che cresce ed elevazione del baco da seta. [The silkworm. Techniques for beginning of a renewed white mulberry growing and silkworm rearing.]** *Terra e Sole.* 43(555): 690-698, 700-704. ISSN: 0040-3768. Notes: 2 tables; 17 ref., In Italian.
NAL Call Number: 16 T273
Descriptors: *Morus alba*, silkworms, varieties, spacing, planting, pruning, tillage, weed control, irrigation, incentives, plant production, environmental protection, sericultural equipment, insect production, control, cultivation, dicotyledons, economic plants, equipment, fibre crops, fruit, implements, industrial crops, Lepidoptera, methods, Moraceae, pest control, plant propagation, plants, production, protection, sericulture, taxonomy, temperate fruits, *Urticales*, useful insects.

Gavioli, F.; Baronio, P. (1988) **Riproduzione nel laboratorio e nelle tecniche di elevazione del *cossus l.* (Lepidoptera, Cossidae) di *Cossus*. [Reproduction in the laboratory and rearing techniques of *Cossus cossus l.* (Lepidoptera, Cossidae).]** *Bollettino dell'Istituto di Entomologia della Universita degli Studi di Bologna.* 42: 87-100. Note: In Italian.
Descriptors: pests, environmental factors, temperature, photoperiod, relative humidity, synthetic diets, rearing techniques, biology, reproduction, agricultural entomology, Lepidoptera, *Cossus cossus*, techniques and methodology, pathogens and biogenic diseases.

Lighthart, B. (1988) **Some changes in gut bacterial flora of field-grown *Peridroma saucia* (Lepidoptera: Noctuidae) when brought into the laboratory.** *Applied and environmental Microbiology.* 54(7): 1896-1898. ISSN: 0099-2240.
NAL Call Number: 448.3 Ap5
Descriptors: gut, bacteria, numeration, environmental factor, laboratory study, diet, field study, Enterobacteriaceae, digestive system, microflora, *Peridroma saucia*, Noctuidae,

Lepidoptera.

Moller, J. (1988) **Investigations on a laboratory culture of the diamond-back moth *Plutella maculipennis curt.* (Lep., Tineidae). II. Influence of larval density on life history parameters of larvae, pupae and adults.** *Journal of Applied Entomology.* 105(5): 425-435. ISSN: 0931-2048.
NAL Call Number: 421 Z36
Descriptors: population density, interactions, pests, biology, environmental factors, ecology, agricultural entomology, Lepidoptera, Yponomeutidae, *Plutella xylostella*, pathogens and biogenic diseases.

Ramoneda, J.; Haro, A. (1988) **Desarrollo larval del perforador del arroz, *walker* de los *suppressalis* de *Chilo* (Lepidoptera: Pyralidae) en el campo y en condiciones del laboratorio. [Larval development of rice borer, *Chilo suppressalis walker* (Lepidoptera: Pyralidae) in the field and in laboratory conditions.]** *Boletin de Sanidad Vegetal.* 14(1): 107-118. ISSN: 0213-6910. Notes: Ills., graphs; 17 ref, In Spanish.
NAL Call Number: SB950 A1S7
Descriptors: *Oryza sativa*, *Chilo*, larvae, life cycle, environmental conditions and control, stem eating insects, biological rhythms, developmental stages, Glumiflorae, Gramineae, injurious factors, Lepidoptera, noxious insects, pests, timing.

Shinkura, K. (1988) **[Effects of rearing conditions on the development and egg production in the original strain of the silkworm, *Bombyx mori*, reared on an artificial diet.]** *Acta Sericologica.* (140): 43-52. ISSN: 0036-4495. Notes: 3 fig.; 8 ref., In Japanese.
NAL Call Number: 425.9 J273S
Descriptors: silkworms, oviposition, compound feeds, environmental conditions, biological development, sericulture, agriculture, insect production, environment, feeds, Lepidoptera, physiological functions, reproduction.

Shinkura, K.; Kato, S.; Takizawa, H. (1988) **[Effect of the temperature and light condition in embryonic and larval stages on the larval development in parent silkworms for hybridization reared on artificial diets.]** *Technical Bulletin of Sericultural Experiment Station.* (132): 129-143. Notes: 36 ref., In Japanese.
Descriptors: silkworms, egg hatchability, environmental temperature, light regimes, growth, feeds, hybridizing, insect products, biological development, breeding methods, eggs, environmental conditions, Lepidoptera, light, methods, physical states, physiological functions, radiations, useful insects.

Simwat, G.S.; Dhawan, A.K.; Sidhu, A.S. (1988) **Laboratory studies on the mortality of diapausing pink bollworm (*Pectinophora gossypiella* (*saund*)) larvae at high temperature.** *Journal of Research, Punjab Agricultural University.* 25(1): 73-76. ISSN: 0048-6019.
NAL Call Number: S19.P8
Descriptors: temperature effects, relative humidity, cotton pest, biology, environmental factors, fibre plants, agricultural entomology, Lepidoptera, Gelechiidae, *Pectinophora gossypiella*, Gossypium.

Suzuki, K. (1988) **[Effect of non-daily short photoperiods on the larval growth and reproductivity of the silkworm, *Bombyx mori*, reared on an artificial diet.]** *Acta Sericological et Entomologica.* (142): 53-64. Notes: 24 ref., In Japanese.
Descriptors: silkworms, reproductive performance, photoperiodicity, growth, larvae, compound feeds, insect developmental stages, environmental factors, light regimes, useful insects.

Tzanakakis, M.E.; Barnes, M.M. (1988) **Larval development and timeliness of pupation in the laboratory of the navel orangeworm, *Amyelois transitella* (*walker*) (Lepidoptera: Phycitidae), on certain diets, under various photoperiod, temperature, aeration and humidity conditions.** *Entomologia hellenica.* 6: 29-41. ISSN: 0254-5381.
NAL Call Number: QL482.G82E6
Descriptors: laboratory study, development, environmental factors, diapause, artificial diet medium, feeding, temperature, photoperiod, humidity, aeration, insect pest, *Amyelois transitella*.

Ueda, S.; Kinoshita, D.; Nojiri, K.; Kato, S.; Suzuki, K. (1988) **[Light control in the rearing of parent silkworms for hybridization reared on artificial diets.]** *Technical Bulletin of Sericultural Experiment Station.* (132): 145-160. Notes: 17 ref., In Japanese.
Descriptors: silkworms, feeds, light, environmental control, sericulture, hybridizing, insect production, breeding methods, Lepidoptera, methods, physical states, radiations, useful insects.

1987

Kamin-Belsky, N.; Wool, D.; Brower, J.H. (1987) **Unplanned factors affecting population size in laboratory populations of the almond moth *Ephestia cautella* (*walker*).** *Proceedings of the Fourth International Working Conference on Stored-Product Protection.* : 463-469. Note: Tel Aviv, Israel, 21-26 September, 1986.
NAL Call Number: SB937 I5 1986
Descriptors: natural enemies, stored products insect pests, relative humidity, biological control, stored flower products, rearing techniques, biology, environmental factors, parasitoids, hosts, wheat, commodities, biodeterioration, international working conference, product protection, Pyralidae, Lepidoptera, Hymenoptera, Ichneumonidae, *Ephestia cautella*, *Bracon hebetor*, *Venturia canescens*, *Cyperales*, biodeterioration, methodology.

Kelleher, M.J.; Rickards, J.; Storey, K.B. (1987) **Strategies of freeze avoidance in larvae of the Goldenrod gall moth, *Epiblema scudderiana*: laboratory investigations of temperature cues in the regulation of cold hardiness.** *Journal of insect physiology.* 33(8): 581-586. ISSN: 0022-1910.
NAL Call Number: 421 J825
Descriptors: Lepidoptera, larva, thermoregulation, overwintering, cryoprotective agent, adaptation, cold, temperature effects, environmental factors, laboratory study, Olethreutidae.

Martinat, P.J.; Allen, D.C. (1987) **Laboratory response of saddled prominent (Lepidoptera:**

Notodontidae) eggs and larvae to temperature and humidity: development and survivorship. *Annals of the Entomological Society of America.* 80(5): 541-546. ISSN: 0013-8746.
NAL Call Number: 420 EN82
Descriptors: development, temperature, humidity, survival, outbreaks, forest trees pest biology, environmental factors, agricultural entomology, *Heterocampa guttivitta*, New York, insect pests of plants, forestry, silviculture.

Mason, L.J.; Pashley, D.P.; Johnson, S.J. (1987) **The laboratory as an altered habitat: phenotypic and genetic consequences of colonization.** *Florida Entomologist.* 70(1): 49-58. ISSN: 0015-4040.
NAL Call Number: 420 F662
Descriptors: rice, maize, soybeans, phenotypes, ecology, habitats, rearing techniques, reviews, laboratory rearing, effects, genetics, pests, techniques, agricultural entomology, *Pseudoplusia includens*, symposium on insects in altered environments, Lepidoptera, *Cynodon dactylon*, *Chrysodeixis includens*, *Spodoptera frugiperda*, Noctuidae, *Oryza*, *Zea mays*, *Glycine*, *Cyperales*, *Fabales*, North America, insect pest of plants, methodology, plant breeding, genetics, pest and parasite management.

Schousboe, C. (1987) **[Observations and experiments with imagines of *Aphomia sociella l.* in laboratory (Pyralidae, Lepidoptera).]** *Entomologiske meddelelser.* 54(2): 149-152. ISSN: 0013-8851. Note: In Danish.
NAL Call Number: 421 EN82
Descriptors: mating, feeding, longevity, egg laying, humidity, sexual behavior, environmental factor.

Wool, D.; Brower, J.H.; Kamin-Belsky, N. (1987) **The relative importance of factors affecting the size of laboratory populations of the almond moth, *Ephestia cautella* (*walker*) (Lep., Pyralidae).** *Journal of Applied Entomology.* 104(3): 217-227. ISSN: 0931-2048.
NAL Call Number: 421 Z36
Descriptors: natural enemies, biological control, stored products pests, parasitoids, hosts, biology, environmental factors, insecticide resistance, Malathion, techniques, CAS Registry Numbers: 121-75-5, Lepidoptera, Hymenoptera, Ichneumonidae, *Ephestia cautella*, *Bracon hebetor*, *Venturia canescens*, organothiophosphate, techniques and methodology, biodeterioration, pesticide resistance, insect pest of plants, control by chemicals and drugs.

1986

Coscolla, R.; Sanchez, J.; Beltran, V. (1986) **Estudio preliminar en el efecto de la humedad relativa de alta temperatura y baja en guarida del *botrana* de *Lobesia* y mortalidad de los huevos de *schiff*. [Preliminary study on the effect of high temperature and low relative humidity on *Lobesia botrana den.* and *schiff.* eggs mortality.]** *Boletin de Sanidad Vegetal.* 12(1): 3-7. Note: In Spanish.
NAL Call Number: SB950 A1S7
Abstract: The effect of high temperature (38-43 degrees C) and low relative humidities (10-22 %) on *Lobesia botrana* eggs mortality was studied in laboratory during different

exposition times. It was observed that at 40 degrees C of temperature and 20 % of relative humidity during 6 hours or 40 degrees C of temperature and 10 % of humidity during 3 hours there was not appreciable mortality. However at 43 degrees C of temperature and 10 % of humidity during 5 h. 30 min. the mortality was notable. In conclusion field observations are necessary for checking the laboratory studies, which are the preliminary contribution in the knowledge of insect eggs natural mortality.
Descriptors: grapevines, air temperature, relative humidity, laboratory experiments, ova, insect and plant developmental stages, atmospheric sciences, climbers, crops, economic plants, environmental conditions and temperature, fruit crops, gametes, humidity, hydrometeorology, injurious factors, meteorology, physiological functions, reproduction, soft fruits, grape berry moths.

Ellington, J.J.; El-Sokkari, A. (1986) **A measure of the fecundity, ovipositional behavior, and mortality of the bollworm, *Heliothis zea* (*boddie*) in the laboratory.** *Southwestern Entomologist.* 11(3): 177-193. ISSN: 0147-1724.
NAL Call Number: QL461.S65
Descriptors: biology, environmental factors, agricultural entomology, *Heliothis zea*, Lepidoptera, *Helicoverpa zea*, Noctuidae, insect pest of plants.

Lopez, J.D. Jr. (1986) **Thermal requirements for diapause termination in laboratory cultures of *Heliothis zea* and *H. virescens* (Lepidoptera: Noctuidae).** *Environmental entomology.* 15(4): 919-923. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: Lepidoptera, diapause, emergence, temperature, laboratory study, life history, pest, environmental factor, Noctuidae, *Heliothis zea*, *Heliothis virescens*.

Nojiri, K.; Niino, T.; Aoki, H.; Hirata, Y. (1986) **[Effects of incubation temperature of pupa for egg production on the egg laying reared on an artificial diet.]** *Acta Sericologica.* (138): 33-41. ISSN: 0036-4495. Notes: 7 ref., In Japanese.
NAL Call Number: 425.9 J273S
Descriptors: silkworms, pupa, incubation, temperature effects, oviposition, developmental stages, Lepidoptera, physiological functions, processing, reproduction.

Petrushova, N.I.; Sokolova, D.V. (1986) **[Laboratory rearing and storage of the codling moth.]** *Trudy Gosudarstvennogo Nikitskogo Botanicheskogo Sada.* 99: 52-60. Note: In Russian.
NAL Call Number: 106 Ia5Z
Descriptors: apple insect pest, diets and nutrition, diapause, environmental factors, photoperiod, temperature, relative humidity, storage, rearing, Lepidoptera, Tortricidae, *Cydia pomonella*, *Malus*, USSR, techniques and methodology.

Silva, R.F. da; Parra, J.R. (1986) **O efeito do photoperiod no desenvolvimento do *hubner* dos *gemmatalis* de *Anticarsia*, 1818 (Lepidoptera, Noctuidae) sob o laboratório condiciona. [Effect of photoperiod on the development of *Anticarsia gemmatalis hubner*, *1818* (Lepidoptera, Noctuidae) under laboratory conditions.]** *Anais da Sociedade Entomologica do Brasil.* 15(2): 201-207. ISSN: 0301-8059. Note: In Portuguese.

NAL Call Number: QL461.S64
Descriptors: photoperiod, sex ratio, soybeans, environmental factors, *Anticarsia gemmatalis*, Leguminosae, *Glycine*, *Fabales*, insect pests of plants, insect reproduction and development.

1985

Boyne, J.V.; Rock, G.C. (1985) **Diapause in *Platynota idaeusalis* (Lepidoptera: Tortricidae): characterization of larval diapause under laboratory and field conditions.** *Environmental entomology.* 14(6): 797-804. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: Lepidoptera, fruit crop, life history, diapause, feeding behavior, molt, respiration, field study, laboratory study, environmental factor, apple pest, Tortricidae, fruit tree, temperature, photoperiod, *Malus domestica*, North Carolina.

Ferreira, M.J.; Parra, J.R. (1985) **Efeito do photoperiod no ciclo de vida de *latipes* de *Mocis* (Guenee, 1852) (Lepidoptera: Noctuidae), sob condições do laboratório. [Effect of the photoperiod on the life cycle of *Mocis latipes* (Guenee, 1852) (Lepidoptera: Noctuidae), under laboratory conditions.]** *Anais da Sociedade Entomologica do Brasil.* 14(1): 89-95. ISSN: 0301-8059. Note: In Portuguese.
NAL Call Number: QL461.S64
Descriptors: biology, environmental factors, *Mocis latipes*, Brazil, insect pests of plants.

Miyazawa, F. (1985) **[Effects of fluctuated temperature on economical character of silkworm reared on an artificial diet at young stage.]** *Gunma Journal of Agricultural Research. Series B. Sericulture.* (2): 33-38. ISSN: 0910-4127. Notes: 13 ref., In Japanese.
Descriptors: silkworms, environmental temperature, compound feeds, environment, conditions, Lepidoptera.

Takizawa, H.; Shinkura, K.; Kato, S. (1985) **[Effect of temperature and humidity on the development of parent silkworm for hybridization reared on artificial diet.]** *Technical Bulletin of Sericultural Experiment Station.* (125): 105-117. ISSN: 0385-3594. Notes: 10 ref., In Japanese.
Descriptors: silkworms, hybridizing, humidity, atmospheric sciences, breeding methods, environment, environmental conditions and temperature, feeding, hydrometeorology, Lepidoptera, meteorology, nutrition, zootechny.

West, R.J.; Laing, J.E. (1985) **Development of the potato stem borer, *Hydraecia micacea* (Lepidoptera: Noctuidae) in the laboratory and field.** *Proceedings of the Entomological Society of Ontario.* 115: 81-87. ISSN: 0071-0768.
NAL Call Number: 420 ON8
Descriptors: insect pest, development, laboratory and field studies, temperature, hatching, emergence, environmental factor.

West, R.J.; Laing, J.E.; Teal, P.E. (1985) **Method for rearing the potato stem borer, *Hydraecia micacea esper* (Lepidoptera: Noctuidae), in the laboratory.** *Journal of*

economic entomology. 78(1): 219-221. ISSN: 0022-0493.
NAL Call Number: 421 J822
Descriptors: Lepidoptera, cereal crop, insect rearing, rearing medium, temperature, Ontario, Canada, pest, environmental factor, *Zea mays*, corn pest.

1984

Fujiyoshi, N.; Yamanaka, M.; Takasaki, T. (1984) **[Effect of temperature on the development of the pink borer, *Sesamia inferens walker*, reared on an artificial diet.]** *Proceedings of the Association for Plant Protection of Kyushu.* (30): 82-85. ISSN: 0385-6410. Notes: 9 ref., In Japanese.
NAL Call Number: SB599 K9
Descriptors: rice, *Sesamia*, biological development, insect production, cereals, economic plants, environment, environmental conditions, grain crops, Lepidoptera, physiological functions, temperature effects.

Henneberry, T.J.; Clayton, T.E. (1984) **Time of emergence, mating, sperm movement, and transfer of ejaculation duct secretory fluid by *Heliothis virescens* (*f.*) (Lepidoptera: Noctuidae) under reversed light-dark cycle laboratory conditions.** *Annals of the Entomological Society of America.* 77(3): 301-305. ISSN: 0013-8746.
NAL Call Number: 420 En82
Descriptors: emergence, mating, Spermatozoa, photoperiod, insect pest reproduction, environmental factors, *Heliothis virescens*.

Herard, F. (1984) **L'étude des rapports trophiques entre *Lymantria dispar* et *suber* de *Quercus* dans le laboratoire conditionne simuler ceux de la forêt de Mamora. I. Rapport général des résultats. [Study of trophic relationships between *Lymantria dispar* and *Quercus suber* in laboratory conditions simulating those of Mamora forest. I. General statement of the results.]** *Actes de l'Institut agronomique et vétérinaire Hassan II.* 4(1): 147-155. ISSN: 0851-0466. Note: In French.
NAL Call Number: S19 A27
Descriptors: Lepidoptera, hardwood forest tree, forest, insect plant relation, temporal coincidence, host plant and substitution, meteorological condition, population dynamics, environmental factor, *Lymantria dispar*, *Quercus suber*, *Quercus ilex*, Morocco.

Kogure, M.; Takei, T.; Fujii, N. (1984) **[Studies on control of nuclear polyhedrosis virus infection in silkworm, *Bombyx mori*, reared on an artificial diet at young stage, 2: Relation between rearing environment on grown silkworm and infectivity to N.P.V.]** *Gunma Journal of Agricultural Research. Series B. Sericulture.* (1): 7-10. ISSN: 0910-4127. Note: In Japanese.
Descriptors: silkworms, Baculoviridae, infectivity, feeds, viruses, growth, environmental conditions, biological development and properties, diseases, environment, injurious factors, Lepidoptera, microbial properties, physiological functions, useful insects.

West, R.J.; Teal, P.E.; Laing, J.E.; Grant, G.M. (1984) **Calling behavior of the potato stem borer, *Hydraecia micacea esper* (Lepidoptera: Noctuidae), in the laboratory and the field.** *Environmental entomology.* 13(5): 1399-1404. ISSN: 0046-225X.

NAL Call Number: QL461.E532
Descriptors: Lepidoptera, cereal crop, sexual behavior, courtship behavior, chemical communication, field study, laboratory study, temperature, insect pest, environmental factor, *Zea mays* corn, Ontario, Canada.

1983

Gohain, R.; Borua, R. (1983) **Effect of temperature and humidity on development, survival and oviposition in laboratory populations of eriworm, *Philosamia ricini* (*boisduval*) (Lepidoptera Saturniidae).** *Archives internationales de Physiologie et de Biochimie.* 91(2): 87-93. ISSN: 0003-9799.
NAL Call Number: QP1 A7
Descriptors: temperature, humidity, life history, laboratory study, reproduction, environmental factors, *Philosamia ricini*, insect populations.

1982

Clayton, T.E.; Henneberry, T.J. (1982) **Pink bollworm: effect of soil moisture and temperature on moth emergence in field and laboratory studies.** *Environmental entomology.* 11(1): 147-149. ISSN: 0046-225X.
NAL Call Number: QL461 E532
Descriptors: Lepidoptera, humidity, temperature, ground, emergence, *Pectinophora gossypiella*, Gelechiidae, pest, laboratory study, field study, environmental factors, ecology.

1980

Jackson, D.M.; Harwood, R.F. (1980) **Survival potential of first instars of the codling moth in laboratory experiments.** *Annals of the Entomological Society of America.* 73(2): 160-163. ISSN: 0013-8746.
NAL Call Number: 420 EN82
Descriptors: *Cydia pomonella*, Tortricidae, food plants, *Malus*, apple, ability to penetrate fruit, first instar larvae, foraging, environmental effects, survival, temperature and humidity effects, nutrition, diet, feeding behavior, ecology, population dynamics, abiotic and physical factors, Heteroneura, Glossata, Lepidoptera.

1978

Sanders, C.J.; Wallace, D.R.; Lucuik, G.S. (1978) **Flight activity of female eastern spruce budworm (Lepidoptera: Tortricidae) at constant temperatures in the laboratory.** *The Canadian entomologist.* 110(6): 627-632. ISSN: 0008-347X.
NAL Call Number: 421 C16
Descriptors: *Choristoneura fumiferana*, dispersion, environmental factor, Lepidoptera, Picea, egg laying, laboratory insect population, temperature effects, Tortricidae, flight, ecology.

1977

Raina, A.K.; Bell, R.A.; Carlson, R.B. (1977) **Influence of temperature on development of an Indian strain of the pink bollworm in the laboratory and observations on fecundity.** *Annals of the Entomological Society of America.* 70(4): 628-630.
NAL Call Number: 420 En82
Descriptors: postembryonic development, environment, fecundity, Gelechiidae, reproduction success, temperature effects, ecology.

1976

Pretorius, L.M. (1976) **Laboratory studies on the developmental and reproductive performance of *Heliothis Armigera* (*huebn.*) on various food plants.** *African entomology: journal of the Entomological Society of Southern Africa.* 39(2): 337-343. ISSN: 0013-8789.
NAL Call Number: 420 En86
Descriptors: Lepidoptera, postembryonic development, environment, *Heliothis*, Noctuidae, insect plant relation, reproduction, breeding success, ecology.

1973

Vassilaina-Alexopoulou, P.; Santorini, A.P. (1973) **Some data on the biology of *Palpita unionalis hubner* (Lepidoptera: Pyralidae), under laboratory conditions.** *Annales.* 10(4): 320-326. Note: Benakeio Phytopathologiko Institouto.
NAL Call Number: 464.9 AT4
Descriptors: postembryonic development, environment, humidity, egg laying, reproduction, temperature effects, insects.

1972

McMorran, A. (1972) **Effects of some environmental factors on the occurrence of second diapause in laboratory-reared *Choristoneura fumiferana* (Lepidoptera: Tortricidae).** *Canadian Entomologist.* 104(10): 1649-1653. ISSN: 0008-347X.
NAL Call Number: 421 C16
Descriptors: diapause, humidity, temperature, biology, trees, agricultural entomology, *Choristoneura fumiferana*, woody plants, Tortricidae, Lepidoptera, insect pests of woody plants, forestry.

Ephemeroptera

2004

Jacobus, L.M.; McCafferty, W.P. (2004) **Contribution to the morphology and descriptive**

biology of *Caurinella idahoensis* (Ephemeroptera: Ephemerellidae). *Western North American Naturalist.* 64(1): 101-108. ISSN: 1527-0904.
NAL Call Number: QH1 .G7
Descriptors: ecology, morphology, Diptera, Ephemeroptera, Nostocaceae, Nostocales, Cyanobacteria, Plecoptera, *Caurinella idahoensis,* adult, egg, larva, male, alate stage, Nearctic species, *Nostoc parmelioides,* colonial blue-green alga, Trichoptera, abdominal segment 9--posterolateral projections, genitalia, reproductive system, rearing apparatus, laboratory equipment, amorphous detritus, clear cold headwater stream, cohabitation, prolonged preemergence behavior, rock surfaces.

2002

Schloss, A.L. (2002) **A laboratory system for examining the influence of light on diel activity of stream macro-invertebrates.** *Hydrobiologia.* 479: 181-190. ISSN: 0018-8158.
NAL Call Number: 410 H992
Descriptors: behavior, Ephemeroptera, *Stenonema modestum*, nymph, macroinvertebrate, light effects, aquatic ecology.

Woodward, G.; Hildrew, A.G. (2002) **Differential vulnerability of prey to an invading top predator: Integrating field surveys and laboratory experiments.** *Ecological Entomology.* 27(6): 732-744. ISSN: 0307-6946.
NAL Call Number: QL461.E4
Descriptors: behavior, freshwater ecology, environmental biology, Ephemeroptera, Odonata, Plecoptera, *Cordulegaster boltonii*, carnivore, predator, mayfly, food, prey, stonefly.

2001

Salas, M.; Dudgeon, D. (2001) **Laboratory and field studies of mayfly growth in tropical Asia.** *Archiv fuer Hydrobiologie.* 153(1): 75-90. ISSN: 0003-9136.
NAL Call Number: QH91 A1 A49
Descriptors: freshwater ecology, Ephemeroptera, *Afronurus* sp., *Baetiella pseudofrequenta*, *Chopralla* sp., *Choroterpes* spp., *Cinygmina* sp., Heptageniidae, Leptophlebiidae, *Procloeon* sp., field cages and equipment, laboratory tanks and equipment, Hong Kong, Lam Tsuen River, Tai Po Kau Forest Stream, food quantity, growth rates, temperature, environmental biology, limnology, comparative and experimental morphology.

1993

Gupta, S.; Michael, R.G.; Gupta, A. (1993) **Laboratory studies on the life cycle and growth of *Cloeon* sp. (Ephemeroptera: Baetidae) in Meghalaya State, India.** *Aquatic insects.* 15(1): 49-55. ISSN: 0165-0424.
NAL Call Number: QL496.A65
Descriptors: life cycle, growth, developmental stage, temperature, environmental factor,

freshwater environment, Meghalaya, India, Baetidae, Ephemeroptera.

1989

Matthews, K.A.; Tarter, D.C. (1989) **Ecological life history, including laboratory respiratory investigation, of the mayfly, *Ameletus tarteri* (Ephemeroptera: Siphloneuridae).** *Psyche (Cambridge).* 96(1-2): 21-37. ISSN: 0033-2615.
NAL Call Number: 421 P95
Descriptors: *Ameletus tarteri*, size, eggs and body size relationship with egg number, oxygen consumption relationship, environmental influences and weight relationship, gut contents, seasonal variations, nymphs, life cycle, growth, emergence from pupa, temporal pattern, population structure, distribution within habitat, habitat preference in streams, chemical factors, temperature, biometrics, whole mayfly physiology, metabolic rate, nutrition, diet, reproduction productivity, development, metamorphosis, ecology, population dynamics, habitat utilization, lotic water, abiotic factors, West Virginia, Cherry River.

Rowe, L.; Berrill, M.; Hollett, L.; Hall, R.J. (1989) **The effects of short-term laboratory pH depressions on molting, mortality and major ion concentrations in the mayflies *Stenonema femoratum* and *Leptophlebia cupida*.** *Hydrobiologia.* 134(1-2): 89-97. ISSN: 0018-8158.
NAL Call Number: 410 H992
Descriptors: *Leptophlebia cupida*, *Stenonema femoratum*, Ephemeroptera, ionic relations, effect of low environmental pH, ecdysis, mortality, body ion concentration, whole mayfly physiology, ion and water relations, life cycle and development, ecology, population dynamics, abiotic factors.

1988

Soderstrom, O. (1988) **Effects of temperature and food quality on life-history parameters in *Parameletus chelifer* and *P. minor* (Ephemeroptera): a laboratory study.** *Freshwater biology.* 20(3): 295-303. ISSN: 0046-5070.
NAL Call Number: QH96.F6
Descriptors: Ephemeroptera, growth, development, quality, feeding, temperature, fecundity, body size, nymph, freshwater environment, laboratory study, mayflies.

1982

Wright, L.L.; Mattice, J.S.; Beauchamp, J.J. (1982) **Effect of temperature and sex on growth patterns in nymphs of the mayfly *Hexagenia bilineata* in the laboratory.** *Freshwater Biology* 12(6): 535-545. ISSN: 0046-5070.
NAL Call Number: QH96.F6
Descriptors: *Hexagenia bilineata*, Ephemeroptera, lethal temperature limit, sexual dimorphism, hatching success, nymph, postembryonic development, growth, mortality, temperature, survival and development relations, whole mayfly physiology, reproduction productivity, life cycle and development, ecology, population dynamics, abiotic factors,

physical factors.

1979

Humpesch, U.H. (1979) **Life cycles and growth rates of *Baetis* Spp. (Ephemeroptera: Baetidae) in the laboratory and in two stony streams in Austria.** *Freshwater Biology.* 9(5): 467-479.
NAL Call Number: QL141 F7
Descriptors: Baetidae, growth, life history, Ephemeroptera, natural conditions study, laboratory study, environmental factor, freshwater stream environment, temperature, ecology, Austria.

Pasternak, K.; Sowa, R. (1979) *Proceedings/2nd International Conference on Ephemeroptera, Polish Academy of Sciences Laboratory of Water Biology, Krakow, August 23-26, 1975.* 321 P.: ILL., Publisher: Warszawa: Panstwowe Wydawnictwo Naukowe, Availability: CNRS-Y16337.
Descriptors: Congress, Ephemeroptera, freshwater environment, mayflies.

Isoptera

2000

Camargo-Dietrich, C.R.; Costa-Leonardo, A.M. (2000) **Comportamento intraspecific dos tenuis de *Heterotermes* da *térmita* (*hagen*) (Isoptera, Rhinotermitidae) no laboratório condiciona. [Intraspecific behavior of the termite *Heterotermes tenuis* (*hagen*) (Isoptera, Rhinotermitidae) in laboratory conditions.]** *Revista Brasileira de Zoologia.* 17(2): 421-427. ISSN: 0101-8175. Note: In Portuguese.
NAL Call Number: QL242 R48
Descriptors: behavior, Isoptera, *Heterotermes tenuis*, Rhinotermitidae, agonistic behavior, arena size, environmental conditions, intraspecific behavior, laboratory conditions, survival, temperature, comparative behaviors.

1999

Fei, H.; Henderson, G. (1999) **Effect of moisture and two nitrogen sources on nest site choice by alates and dealates of *Coptotermes formosanus* in the laboratory (Isoptera: Rhinotermitidae).** *Sociobiology.* 34(3): 581-589. ISSN: 0361-6525.
NAL Call Number: QH549.S6
Descriptors: glutamic acid, urea, nesting choices, moisture, environmental factors, insect behavior, CAS Registry Numbers: 56-86-0 and 57-13-6, *Coptotermes formosanus*, Isoptera, Rhinotermitidae, ecology, insect pests of plants.

Jmhasly, P.; Leuthold, R.H. (1999) **The system of underground passages in *Macrotermes subhyalinus* and comparison of laboratory bioassays to field evidence of intraspecific encounters in *M. subhyalinus* and *M. bellicosus* (Isoptera, Termitidae).**

Insectes Sociaux. 46(4): 332-340. ISSN: 0020-1812.
NAL Call Number: 421 IN79
Descriptors: subterranean termite ecology, environmental biology, *Macrotermes bellicosus*, *Macrotermes subhyalinus*, aggression, feeding territory, intraspecific encounter, storage pit, underground passage, behavioral biology, subterranean bioresearch, nutritional status and methods, comparative study, Ivory Coast, Ethiopian region.

1998

Maistrello, L.; Sbrenna, G. (1998) **Behavioral profiles in laboratory colonies of *Kalotermes flavicollis* (Isoptera: Kalotermitidae) with different social environments.** *Sociobiology.* 31(1): 91-104. ISSN: 0361-6525.
NAL Call Number: QH549.S6
Descriptors: social behavior, biology, agricultural entomology, *Kalotermes flavicollis*, Kalotermitidae, Isoptera, comparative study.

1997

Mishra, S.C.; Thakur, M.L. (1997) **Laboratory evaluation of natural resistance of bamboos to termites.** *Journal of the Bombay Natural History Society.* 94(2): 443-445. ISSN: 0006-6982.
NAL Call Number: 513 B63
Descriptors: terrestrial ecology, pest assessment control and management, *Microcerotermes beesoni*, termite, Isoptera, natural resistance, comparative and experimental morphology, physiology and pathology, environmental biology, India, Asia, Oriental region, Dehra Dun.

Sepulveda, L.E. (1997) **Encierro en jerarquías del laboratorio de los *quadricollis* de *Porotermes* (*rambuar, 1842*) (Isoptera: Termopsidae). [Closure in laboratory nests of *Porotermes quadricollis* (*rambuar, 1842*) (Isoptera: Termopsidae).]** *Gayana Zoologia.* 61(2): 109-112. ISSN: 0016-531X. Note: In Spanish.
NAL Call Number: 410 G25
Descriptors: terrestrial ecology, Hymenoptera, Isoptera, *Camponotus morosus*, Formicidae, *Porotermes quadricollis*, artificial nests, behavior, closure, environmental biology.

1995

Curtis, A.D.; Waller, D.A. (1995) **Changes in nitrogen fixation rates in termites (Isoptera: Rhinotermitidae) maintained in the laboratory.** *Annals of the Entomological Society of America.* 88(6): 764-767. ISSN: 0013-8746.
NAL Call Number: 420 EN82
Descriptors: ecology, enzymology, biochemistry and molecular biophysics, metabolism, eubacteria, bacteria, Isoptera, *Reticulitermes flavipes*, *Reticulitermes virginicus*, nitrogen, field rate, nitrogenase activity, symbiosis, temperature effects, enzymes, physiological

studies, metabolism, metabolic pathways, bacteriology, biochemistry, comparative study.

Yamaoka, R. (1995) **[Guide pheromone of termites inhabiting in forest of Sakaerat environment laboratory (Nakhon Ratchasima).]** *Kyoto Institute of Technology, Faculty of Textual Science.* : 84-86. Baiorisaikuru, sono Kihonteki Kiko to Barieshon. Heisei 4,6 Nendo, No.04304002, Journal Number: N19951133L. Note: In Japanese.
Descriptors: Isoptera, pheromone, tropical rain forest, species specificity, Thailand, Pterygota, tropical forest, biological comparison, laboratory rearing, Southeast Asia.

1993

Wells, J.D.; Henderson, G. (1993) **Fire ant predation on native and introduced subterranean termites in the laboratory: Effect of high soldier number in *Coptotermes formosanus*.** *Ecological Entomology.* 18(3): 270-274. ISSN: 0307-6946.
NAL Call Number: QL461.E4
Descriptors: ecology, physiology, Hymenoptera, *Eristalis abusivus*, Diptera, *Eristalis arbustorum*, *Eristalis horticola*, *Eristalis nemorum*, Isoptera, color pattern, development, seasonality, sexual dimorphism, behavioral biology, environmental biology, comparative and experimental morphology, physiology and pathology.

1992

Fernandes, P.M.; Alves, S.B. (1992) **Laboratory feeding and plant damage of *Cornitermes cumulans* (*kollar, 1832*) (Isoptera-termitidae).** *Anais da Sociedade Entomologica do Brasil.* 21(2): 125-132. ISSN: 0301-8059.
NAL Call Number: QL461.S64
Descriptors: ecology, economic entomology, nutrition, physiology, Isoptera, Leguminosae, Lepidoptera, *Etiella behrii*, ecology, host plant, life history, parasitoid, pathogen, predator, behavioral biology, environmental biology, nutritional status and methods, comparative study.

1987

Cookson, L.J. (1987) **Influence of laboratory maintenance, relative humidity and coprophagy on (14C) lignin degradation by *Nasutitermes exitiosus*.** *Journal of Insect Physiology.* 33(10): 683-687. ISSN: 0022-1910.
NAL Call Number: 421 J825
Descriptors: starvation, relative humidity, lignin, degradation, ecology, environmental factors, insect physiology, agricultural entomology, CAS Registry Numbers: 9005-53-2, Isoptera, *Acer rubrum*, *Nasutitermes exitiosus*, *Sapindales*, prokaryotes, Termitidae, pests, insect physiology and biochemistry.

1986

Grace, J.K. (1986) **A simple humidity chamber for maintaining subterranean termites**

(Isoptera: Rhinotermitidae) in the laboratory. *Pan-Pacific Entomologist.* 62(3): 221-223. ISSN: 0031-0603.
NAL Call Number: 421 P193
Descriptors: *Reticulitermes hesperus*, Isoptera, environmental control device, simple humidity chamber, applications, care in captivity, housing techniques.

1979

Abu, S.F.; Abdel, N.H. (1979) **Standard method for the maintenance of laboratory colonies of the common sudanese sand termite (*Psammotermes hybostoma desneux*, Rhinotermitidae, Isoptera).** *Sudan Notes and Records.* 60: 110-113. ISSN: 0375-2984.
NAL Call Number: 515 SU2
Descriptors: *Psammotermes hybostoma*, Isoptera, laboratory colony maintenance, environmental influences and implications, survival, environmental influences, humidity, temperature, techniques, care in captivity, ecology, population dynamics, abiotic and physical factors.

Psocoptera

1999

Wang, J.; Zhao, Z.; Li, L. (1999) **[An ecological study on the laboratory population of psocid, *Liposcelis bostrychophila badonnel* (Psocoptera: Liposcelididae).]** *Acta Entomologica Sinica.* 42(3): 277-283. ISSN: 0454-6296. Note: In Chinese.
NAL Call Number: 421 K96
Descriptors: development, ecology, population studies, reproductive system, Corrodentia, *Liposcelis bostrychophila*, psocid, egg female, development, diet, fecundity, growth, relative humidity, survival, temperature, comparative study, environmental biology.

1981

Menchaca-Lopez, L.B.; Garcia-Aldrete, A.G. (1981) **Biological cycle and demographic data of *Lachesilla fuscipalpis badonnel* and *garcia-aldrete* (Psocoptera, Lachesillidae) under laboratory conditions.** *Folia entomológica mexicana.* (48): 16. ISSN: 0430-8603.
NAL Call Number: 421 F712
Descriptors: Psocoptera, rearing, laboratory study, life history, temperature, humidity, environmental factor, barklice.

Miscellaneous

2004

Fielden, L.J.; Krasnov, B.R.; Khokhlova, I.S.; Arakelyan, M.S. (2004) **Respiratory gas exchange in the desert flea *Xenopsylla ramesis* (Siphonaptera: Pulicidae): Response**

to temperature and blood-feeding. *Comparative Biochemistry and Physiology Part A Molecular & Integrative Physiology.* 137A(3): 557-565. ISSN: 1095-6433.
NAL Call Number: QP1.C6
Descriptors: metabolism, physiology, terrestrial ecology, Siphonaptera, gerbilline rodent, Cricetidae, *Xenopsylla ramesis,* desert flea, carbon dioxide emissions, respirometry, laboratory techniques, ambient temperature, blood feeding, environmental extremes, life cycle, metabolic rates and responses, microenvironment, parasitism, respiratory gas exchange, starvation, temperature response, thermal sensitivity, environmental biology, Middle East.

Wissinger, S.; Steinmetz, J.; Alexander, J.S.; Brown, W. (2004) **Larval cannibalism, time constraints, and adult fitness in caddisflies that inhabit temporary wetlands.** *Oecologia.* 138(1): 39-47. ISSN: 0029-8549.
NAL Call Number: QL750 O3
Descriptors: behavior, development, evolution and adaptation, terrestrial ecology, Trichoptera, *Asynarchus nigriculus,* caddisfly, dietary supplementation, cannibalism, detritus quality, development times, emergence dates, fecundity, fitness, habitat drying, laboratory experiments, life history, resource allocation, survival, temporary wetlands, environmental biology.

2002

Petavy, G. (2002) **Douleur, douleur et effort dans les arthropodes. [Pain, suffering and stress in arthropods.]** *STAL. Sciences et techniques de l'animal de laboratoire.* 27: 37-42. ISSN: 0339-722X. Note: Numero Special. Ethique et Invertebres, In French.
Descriptors: euthanasia, arthropod care, Crustacea, Hymenoptera, anesthesia, insect experimentation legislation, pain, stress, suffering, laboratory insects, comparative and experimental morphology, physiology and pathology.

2000

Gavloski, J.E.; R.J. Lamb (2000) **Compensation for herbivory in cruciferous plants: specific responses to three defoliating insects.** *Environmental entomology.* 29(6): 1258-1267. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Abstract: Plant compensation may be specific to the defoliation of a particular insect herbivore, or a generalized response to herbivory. These alternate hypotheses were tested by measuring biomass and seed production of *Brassica napus l.* and *Sinapis alba l.* in response to 0, 25, or 75% defoliation of seedling plants. The herbivores were adults of *Phyllotreta cruciferae* (*goeze*), larvae of *Plutella xylostella l.*, and larvae of *Mamestra configurata* (*walker*). Although defoliated to the same extent, both *B. napus* and *S. alba* compensated most for defoliation by *M. configurata* and least for defoliation by *P. cruciferae*. Both plant species compensated better for 25% than for 75% defoliation, and *S. alba* compensated better than *B. napus*. Laboratory and field experiments showed similar patterns of compensatory leaf growth, but recovery was more rapid in a controlled environment. Compensation was associated with changes in root biomass that

were correlated with foliage biomass, indicating that root-shoot ratios were maintained. Complete recovery of foliage after defoliation did not assure complete recovery of plant fitness. For these three herbivorous insects, compensation by two plant species for defoliation was specific to the insect defoliator, and not a generalized response to herbivory. The compensatory responses of the two plant species explain, in part, the differential impact the three herbivores have on the crops.
Descriptors: *Phyllotreta cruciferae*, Coleoptera, *Plutella xylostella*, Lepidoptera, *Mamestra configurata*, herbivores, *Brassica napus*, *Sinapis alba*, defoliation, compensatory growth, regrowth, leaves, roots, root shoot ratio, seed output, Manitoba.

Thomas, D.J.; J.A. Morgan; J.M. Whipps; J.R. Saunders (2000) **Plasmid transfer between the *Bacillus thuringiensis* subspecies *kurstaki* and *tenebrionis* in laboratory culture and soil and in lepidopteran and coleopteran larvae.** *Applied and environmental microbiology.* 66(1): 118-124. ISSN: 0099-2240.
NAL Call Number: 448.3 Ap5
Abstract: Plasmid transfer between *Bacillus thuringiensis* subsp. *kurstaki HD1* and *B. thuringiensis* subsp. *tenebrionis* donor strains and a streptomycin-resistant *B. thuringiensis* subsp. *kurstaki* recipient was studied under environmentally relevant laboratory conditions in vitro, in soil, and in insects. Plasmid transfer was detected in vitro at temperatures of 5 to 37 degrees C, at pH 5.9 to 9.0, and at water activities of 0.965 to 0.995, and the highest transfer ratios (up to 10(-1) transconjugant/donor) were detected within 4 h. In contrast, no plasmid transfer was detected in nonsterile soil, and rapid formation of spores by the introduced strains probably contributed most to the lack of plasmid transfer observed. When a *B. thuringiensis* subsp. *kurstaki* strain was used as the donor strain, plasmid transfer was detected in killed susceptible lepidopteran insect (*Lacanobia oleracea*) larvae but not in the nonsusceptible coleopteran insect *Phaedon chocleriae*. When a *B. thuringiensis* subsp. *tenerbrionis* strain was used as the donor strain, no plasmid transfer was detected in either of these insects even when they were killed. These results show that in larger susceptible lepidopteran insects there is a greater opportunity for growth of *B. thuringiensis* strains, and this finding, combined with decreased competition due to a low initial background bacterial population, can provide suitable conditions for efficient plasmid transfer in the environment.
Descriptors: genetic transformation, Lepidoptera, Coleoptera, larvae, comparison study.

1999

Cowger, N.L.; K.C. O'Connor; T.G. Hammond; D.J. Lacks; G.L. Navar. (1999) **Characterization of bimodal cell death of insect cells in a rotating-wall vessel and shaker flask.** *Biotechnology and bioengineering.* 64(1): 14-26. ISSN: 0006-3592.
NAL Call Number: 381 J8224
Abstract: In previous publications, we reported the benefits of a high-aspect rotating-wall vessel (HARV) over conventional bioreactors for insect-cell cultivation in terms of reduced medium requirements and enhanced longevity. To more fully understand the effects that HARV cultivation has on longevity, the present study characterizes the mode and kinetics of *Spodoptera frugiperda* cell death in this quiescent environment relative to a shaker-flask control. Data from flow cytometry and fluorescence microscopy show a greater accumulation of apoptotic cells in the HARV culture, by a factor of at least 2 at

the end of the cultivation period. We present a kinetic model of growth and bimodal cell death. The model is unique for including both apoptosis and necrosis, and further, transition steps within the two pathways. Kinetic constants reveal that total cell death is reduced in the HARV and the accumulation of apoptotic cells in this vessel results from reduced depletion by lysis and secondary necrosis. The ratio of early apoptotic to necrotic cell formation is found independent of cultivation conditions. In the model, apoptosis is only well represented by an integral term, which may indicate its dependence on accumulation of some factor over time; in contrast, necrosis is adequately represented with a first-order term. Cell-cycle analysis shows the percent of tetraploid cells gradually decreases during cultivation in both vessels. For example, between 90% and 70% viability, tetraploid cells in the HARV drop from 43 +/- 1% to 24 +/- 4%. The data suggests the tetraploid phase as the likely origin for apoptosis in our cultures. Possible mechanisms for these changes in bimodal cell death are discussed, including hydrodynamic forces, cell-cell interactions, waste accumulation, and mass transport. These studies may benefit insect-cell cultivation by increasing our understanding of cell death in culture and providing a means for further enhancing culture longevity.
Descriptors: insects, cells, bioreactors, insect cell cultivation, apoptosis, culture longevity.

Gibbs, A.G. (1999) **Laboratory selection for the comparative physiologist.** *Journal of Experimental Biology.* 202(20): 2709-2718. ISSN: 0022-0949.
NAL Call Number: 442.8 B77
Descriptors: selection, experimentation, laboratory, evolution, in house mice, nest building behavior, *Drosophila melanogaster*, desiccation and stress resistance, thermal sensitivity, environmental stress, natural selection, high temperature, *Mus domesticus*.

Manachini, B.; Agosti, M.; Rigamonti, I. (1999) Environmental impact of Bt-corn on non target entomofauna: synthesis of field and laboratory studies. *Human and environmental exposure to xenobiotics.* : 873-882. ISBN: 88-7830-299-6. Notes: Proceedings of the XI Symposium Pesticide Chemistry, Cremona, Italy, 11-15 September, 1999. Editors: Del Re, A. A. M.; Brown, C.; Capri, E.; Errera, G.; Evans, S. P.; Trevisan, M.
NAL Call Number: SB950.93 S56 1999
Descriptors: maize, transgenic plants, crystal proteins, endotoxins, nontarget effects and organisms, soil fauna, predators, natural enemies, biodiversity, pesticides, agricultural entomology, *Zea mays*, *Bacillus thuringiensis* subsp. *kurstaki*, *Chrysoperla carnea*, *Rhopalosiphum padi*, Carabidae, Italy, Poaceae, *Cyperales*, Firmicutes, bacteria, prokaryotes, Neuroptera, Rhopalosiphum, Sternorrhyncha, Homoptera, Hemiptera, Coleoptera, Southern Europe, biotechnology, biological resources, host resistance and immunity.

1998

Chang, S.H.; H.L. Sun; Z.H. Li (1998) **Effect of temperature oscillation on insect cell growth and baculovirus replication.** *Applied and environmental microbiology.* 64(6): 2237-2239. ISSN: 0099-2240.
NAL Call Number: 448.3 Ap5
Abstract: Temperature oscillation can enhance cell viability of sf9 insect cells and

baculovirus production of occlusion bodies (OB) and extracellular virus (ECV) compared with constant temperature in stationary culture and suspension culture. The optimal oscillation range was 24 to 28 degrees C. At this temperature oscillation, the viability of uninfected and infected sf9 cells can be maintained much longer than at 28 degrees C. Although the rate of virus infection was a little low at 24 to 28 degrees C, the final cell infectivity was similar to that at a constant temperature of 28 degrees C. The production of OB was increased from 13.4 to 17.4/cell in stationary culture and from 13.9/cell to 18.1/cell in suspension culture. The titer of ECV was increased from 87 to 114 PFU/cell in stationary culture and from 79 to 114 PFU/cell in suspension culture.
Descriptors: *Spodoptera frugiperda*, nuclear polyhedrosis viruses, viral replication, virus infection.

Chun, Y.S.; Ryoo, M.I.; Choi, W.I. (1998) **Influences of resource patch distribution on a host-parasitoid system stability in patchy environment: a laboratory study.** *Journal of Asia-Pacific Entomology.* 1(2): 223-234. ISSN: 1226-8615.
Descriptors: *Sitophilus oryzae*, Curculionidae, Hymenopteran parasites, *Anisopteromalus calandrae*, parasitism effect on host abundance on plant host, influence of plant host spatial distribution, *Sativa oryzae*, rice, prevalence in presence/absence of hymenopteran parasite, plant/ host spatial distribution and intraspecific competition, prevalence and plant host spatial distribution relationships, Pteromalidae, Coleopteran hosts, parasitism effect on host abundance, parasites diseases and disorders, ecology, competition, Polyphaga, Coleoptera, Chalcidoidea, Terebrantia, Apocrita, beetles.

Fuller, R.L.; Ribble, C.; Kelley, A.; Gaenzle, E. (1998) **Impact of stream grazers on periphyton communities: A laboratory and field manipulation.** *Journal of Freshwater Ecology.* 13(1): 105-114. ISSN: 0270-5060.
NAL Call Number: QH541.5 F7J68
Descriptors: freshwater ecology, Ephemeroptera, Trichoptera, periphyton, *Psilotreta*, *Stenonema*, grazing effects, growth, species abundance, species density, survivorship, environmental biology, developmental biology, embryology, comparative study.

1997

Mitsunaga, T.; Fuji, K. (1997) **The effects of spatial and temporal environmental heterogeneities on persistence in a laboratory experimental community.** *Researches on Population Ecology* (*Kyoto*). 39(2): 249-260. ISSN: 0034-5466.
NAL Call Number: 420 K99
Descriptors: parasitology, terrestrial ecology, Coleoptera, Hymenoptera, Leguminosae, bean weevil, parasite host, kidney bean, wasp, attack rate, community dynamics, environmental heterogeneity, spatial, temporal, environmental biology, comparative study.

Ostrom, P.H.; Colunga-Garcia, M.; Gage, S.H. (1997) **Establishing pathways of energy flow for insect predators using stable isotope ratios: field and laboratory evidence.** *Oecologia (Berlin).* 109(1): 108-113. ISSN: 0029-8549.
NAL Call Number: QL750.O3
Descriptors: ecology, metabolism, physiology, radiology, medical sciences, Coleoptera,

Coleomegilla maculate, *Hippodamia variegate*, carbon-13, nitrogen-15, research article, analytical method, energy flow, food web, stable isotope ratio, terrestrial ecology, radiation-radiation and isotope techniques, environmental biology, energy and respiratory metabolism, comparative study.

Shimoda, T.; Takabayashi, J.; Ashihara, W.; Takafuji, A. (1997) **Response of predatory insect *Scolothrips takahashii* toward herbivore-induced plant volatiles under laboratory and field conditions.** *Journal of Chemical Ecology.* 23(8): 2033-2048. ISSN: 0098-0331.
NAL Call Number: QD415.A1J6
Descriptors: behavior, biochemistry and molecular biophysics, ecology, economic entomology, horticulture, nutrition, Acarina, Chelicerata, Arachnida, Leguminosae, Thysanoptera, lima bean, two-spotted spider mite, *Scolothrips takahashii*, *Tetranychus urticae*, herbivore-induced plant volatiles, laboratory equipment, leaves, pest management, tritrophic interactions, y-tube olfactometer, environmental biology.

1996

Tuda, M. (1996) **Temporal/spatial structure and the dynamical property of laboratory host-parasitoid systems.** *Researches on Population Ecology (Kyoto).* 38(2): 133-140. ISSN: 0034-5466.
NAL Call Number: 420 K99
Descriptors: ecology, parasitology, physiology, Coleoptera, Hymenoptera, azuki bean, mung bean, *Callosobruchus maculates*, *Callosobruchus phaseoli*, *Heterospilus prosopidis*, adult, carrying capacity, host, host population structure, host-parasitoid systems, larva, parasitoid, persistence, population studies, resource competition, vulnerable period, comparative study.

1995

Larsen, K.S. (1995) **Laboratory rearing of the squirrel flea *Ceratophyllus sciurorum sciurorum* with notes on its biology.** *Entomologia Experimentalis et Applicata.* 76(3): 241-245. ISSN: 0013-8703.
NAL Call Number: 421 EN895
Descriptors: ecology, economic entomology, reproductive system, Mustelidae, Siphonaptera, *Ceratophyllus sciurorum sciurorum*, behavior, farmed mink, life history, pest.

Palmer, T.M. (1995) **The influence of spatial heterogeneity on the behavior and growth of two herbivorous stream insects.** *Oecologia.* 104(4): 476-486. ISSN: 0029-8549.
NAL Call Number: QL750.O3
Descriptors: aquatic insects, growth, behavior patterns, spatial variation, aquatic environment, velocity, laboratory tests.

Roush, R.T.; Hopper, K.R. (1995) **Use of single family lines to preserve genetic variation in laboratory colonies.** *Annals of the Entomological Society of America.* 88(6): 713-717.

ISSN: 0013-8746.
NAL Call Number: 420 EN82
Descriptors: conservation, ecology, economic entomology, enzymology, biochemistry and molecular biophysics, genetics, physiology, population genetics, adaptation, allele frequency, allozymes, biological control, conservation, genetic drift, homozygosity, inbreeding, population size, selection, conservation, cytogenetics.

1993

Cronin, J.T.; Strong, D.R. (1993) **Substantially submaximal oviposition rates by a mymarid egg parasitoid in the laboratory and field.** *Ecology.* 74(6): 1813-1825. ISSN: 0012-9658.
NAL Call Number: 410 Ec7
Descriptors: ecology, parasitology, pathology, physiology, Homoptera, Hymenoptera, ambush predator, behavior, optimal foraging, spatial heterogeneity, environmental biology, parasitology, comparative and experimental morphology, pathology, oceanography and limnology, reproductive system, biochemistry, developmental biology, embryology, morphogenesis.

1992

Heath, R.R.; A. Manukian (1992) **Development and evaluation of systems to collect volatile semiochemicals from insects and plants using a charcoal-infused medium for air purification.** *Journal of chemical ecology.* 18(7): 1209-1226. ISSN: 0098-0331.
NAL Call Number: QD415.A1J6
Abstract: A system is described for the collection of volatiles produced by plants and insects that minimizes stresses on the plant or insect in an environment that is free from chemical impurities. Air entering a volatile collection chamber containing insects and/or plants was purified using a nonwoven fabric medium infused with charcoal. When three layers of this material were used, the total amount of impurities detected by gas chromatography was less than 40 ng/hr at a collection rate of 1 L/min. The air filtration system can maintain this level of air purification for 96 hr at an air flow of 0.43 m/sec, or a total volume of approximately 750,000 L of air. The air filtration system did not alter the relative humidity of the purified air compared to the relative humidity of ambient air. A multiport collector system was developed for use with the insect volatile collection system and enabled up to three samples to be collected without disturbing the system.
Descriptors: plants, semiochemicals, insect volatile compounds, collectors, air filters.

Lai, C.H.; Yoshida, T. (1992) **Population stability in laboratory ecosystem of stored product insects and parasitoids.** *Chinese Journal of Entomology.* 12(3): 183-191.
NAL Call Number: QL461 C465
Descriptors: ecology, economic entomology, parasitology, physiology, reproductive system, reproduction, Coleoptera, Hymenoptera, Lepidoptera, *Anisopteromalus calandrae*, *Callosobruchus chinensis*, *Choetospila elegans*, *Lariophagus distinguendus*, *Rhyzopertha dominica*, *Sitophilus oryzae*, *Sitophilus zeamais*, community complexity, population density, population dynamics, environmental biology, comparative study.

1990

Cooke, B.D. (1990) **Notes on the comparative reproductive biology and the laboratory breeding of the rabbit flea *Xenopsylla cunicularis smit* (Siphonaptera: Pulicidae).** *Australian journal of zoology.* 38(5): 527-534. ISSN: 0004-959X.
NAL Call Number: 410 Au73
Descriptors: Xenopsyllidae, parasite, vector, myxomatosis, *Oryctolagus cuniculus*, reproduction, growth, survival, development, environmental factor, humidity, Siphonaptera, viral disease, infection, Lagomorpha.

Shumiya, S. (1990) **Laboratory animals for aging research. Laboratory animals for aging research. Future development.** *Seibutsu no Kagaku iden (Heredity).* 44(4): 36-41. ISSN: 0387-0022. Note: Journal Number: F0863AAK.
NAL Call Number: 443.8 ID2
Descriptors: laboratory species, senile change and disease, Alzheimer disease, experimental disease, lifetime, habitat environment, controlled diet, environmental effect, dietary effect, *Meriones unguiculatus*, *Suncus murinus*, organism, aging, physiology, variation, presenile dementia, brain disease, central nervous system disease, basal ganglia disease, model, environment, effect, Myomorpha, Soricidae, Insectivora.

Wagner, R. (1990) **A laboratory study on the life cycle of *Sericostoma personatum* (*kirby* and *spence*), and light dark-dependent food consumption.** *Hydrobiologia.* 208(3): 201-212. ISSN: 0018-8158.
NAL Call Number: 410 H992
Descriptors: Trichoptera, life history, photoperiod, feeding, temperature, freshwater environment.

1989

Haefner, J.W.; Abbott, L.C. (1989) **Extrapolation of laboratory pH dose-response data to fluctuating environments: comparisons with a null model.** *Canadian Journal of Fisheries and Aquatic Sciences.* 46(9): 1499-1509. ISSN: 0706-652X.
NAL Call Number: 442.9 C16J
Descriptors: *Gammarus lacustris*, Amphipoda, *Isoperla fulva*, *Pteronarcella badia*, Plecoptera, ecological modelling, survival, null model for laboratory pH dose response data, extrapolation to fluctuating environments, external pH, ecological techniques, population dynamics, abiotic factors, chemical factors, Peracarida, Eumalacostraca, Malacostraca, Crustacea, stoneflies.

Ramzan, M.; Chahal, B.S. (1989) **Effect of initial infestation levels of three common species of stored grain pests on their population build-up at constant laboratory conditions.** *Journal of Research, Punjab Agricultural University.* 26(1): 71-76. ISSN: 0048-6019.
NAL Call Number: S19.P8
Descriptors: stored products, pests, development, growth, relative humidity, temperature, population dynamics, cereal grains, environmental factors, wheat, commodities, biodeterioration, agricultural entomology, Coleoptera, Curculionidae, Dermestidae,

Tenebrionidae, *Sitophilus oryzae*, *Trogoderma granarium*, *Tribolium castaneum*, Triticum, Gramineae, *Cyperales*, biodeterioration, pathogens and biogenic diseases of plants.

1988

Fuller, R.L.; Destaffan, P.A. (1988) **A laboratory study of the vulnerability of prey to predation by three aquatic insects.** *Canadian Journal of Zoology.* 66(4): 875-878. ISSN: 0008-4301.
NAL Call Number: 470 C16D
Descriptors: predator prey relation, Plecoptera, Megaloptera, laboratory study, freshwater environment, Baetidae, Ephemerellidae, Simuliidae, Ephemeroptera, Diptera.

Grace, B.; J.L. Shipp (1988) **A laboratory technique for examining the flight activity of insects under controlled environment conditions.** *International journal of biometeorology.* 32(1): 65-69. ISSN: 0020-7128. Note: Lisse: Swets and Zeitlinger.
NAL Call Number: 340.8 IN8
Descriptors: *Simulium arcticum*, insect behavior, flight, environmental factors, humidity, daylight, temperature, wind speed, correlation, Alberta, Canada.

1987

Elkarmi, L.A.; Harris, M.K.; Morrison, R.K. (1987) **Laboratory rearing of *Chrysoperla rufilabris* (*burmeister*), a predator of insect pests.** *Southwestern Entomologist.* 12(1): 73-78. ISSN: 0147-1724.
NAL Call Number: QL461.S65
Descriptors: *Chrysoperla rufilabris*, Neuroptera, procedures evaluation, weight, eggs, reproductive productivity, rearing techniques and conditions, fecundity, comparison with *Chrysoperla carnea*, environmental influences, larva, developmental period, photoperiod, temperature, fecundity relationship, captive rearing programme, care in captivity, biometrics, reproduction, life cycle, developmental stages, abiotic factors, physical factors, light.

1985

Osbrink, W.L.; Rust, M.K. (1985) **Cat flea (Siphonaptera: Pulicidae): factors influencing host-finding behavior in the laboratory.** *Annals of the Entomological Society of America.* 78(1): 29-34. ISSN: 0013-8746.
NAL Call Number: 420 En82
Descriptors: Siphonaptera, spatial orientation, host selection, temperature, vision, stimulus, Pulicidae, thermotaxis, environmental factor.

Ryazanova, G.I.; Mazokhin-Porshnyakov, G.A. (1985) **[Spatial interaction of the *Calopteryx splendens* (Odonata, Calopterygidae) larvae in a laboratory experiment.]** *Zoologiceskij Zurnal.* 64(9): 1360-1367. ISSN: 0044-5134. Note: In Russian.
NAL Call Number: 410 R92

Descriptors: Odonata, larva, territorial behavior, spatial distribution, Calopterygidae, freshwater environment.

1984

Burton, R.L.; W.D. Perkins (1984) **Containerization for rearing insects.** *Advances and challenges in insect rearing* / edited by E.G. King and N.C. Leppla. : 51-56. New Orleans: Agricultural Research Service, Southern Region, U.S. Dept. of Agriculture.
NAL Call Number: aSF518.A3 1984
Descriptors: rearing techniques, containers, design, environment.

Elliott, J.M. (1984) **Hatching time and growth of *Nemurella pictetii* (Plecoptera: Nemouridae) in the laboratory and a Lake District stream.** *Freshwater biology.* 14(5): 491-499. ISSN: 0046-5070.
NAL Call Number: QH96.F6
Descriptors: Plecoptera, life history, Great Britain, Nemouridae, freshwater environment, comparison study.

Shapiro, M. (1984) **Micro-organisms as contaminants and pathogens in insect rearing.** *Advances and challenges in insect rearing* / edited by E.G. King and N.C. Leppla. : 130-142. New Orleans: Agricultural Research Service, Southern Region, U.S. Dept. of Agriculture.
NAL Call Number: aSF518.A3 1984
Descriptors: laboratory rearing, environment, microbial contamination, pathogens, facilities, treatment.

Shepard, R.B.; Minshall, G.W. (1984) **Selection of fine-particulate foods by some stream insects under laboratory conditions.** *American midland naturalist.* 1111(1): 23-32. ISSN: 0003-0031.
NAL Call Number: 410 M58
Descriptors: Plecoptera, freshwater environment, diet, food, selection, United States, season, Coprophagous, trophic relation and chain, Baetidae, Ephemerellidae.

1982

Marrone, P.G. (1982) **An inexpensive technique for controlling soil moisture in laboratory experiments with insects requiring growing plants.** *Pedobiologia.* 24(2): 121-127. ISSN: 0031-4056.
NAL Call Number: 56.8 P343
Descriptors: environmental control device, ecological techniques, inexpensive soil moisture controlling technique, insect care in captivity, housing techniques.

1981

Beerwinkle, K.R.; March, P.A. (1981) **A cam-operated, electronic proportional-control system for laboratory simulation of outside summer temperatures.** *Southwestern*

Entomologist. 6(1): 53-56. ISSN: 0147-1724.
NAL Call Number: QL461.S65
Descriptors: comprehensive zoology, environmental control device, temperature, simulation control system, *Haematobia irritans*, Muscidae, dung habitat, temperature effect on larval migration, laboratory simulation, care in captivity, housing techniques, terrestrial habitat, abiotic factors, physical factors, Cyclorrhapha, Brachycera, Diptera, true flies.

Brown, J.J.; Hussain, Y.B. (1981) **Physiological effects of volcanic ash upon selected insects in the laboratory.** *Melanderia.* 37: 30-35. ISSN: 0076-6224.
NAL Call Number: QL651 M4
Descriptors: mortality, laboratory study, natural disaster, abrasion, *Apis mellifica*, Blattidae, volcanic ash, Coleoptera, cuticle, desiccation, Diptera, environmental factor, *Galleria mellonella*, Hymenoptera, Lepidoptera, *Musca domestica*, *Osmia lignaria*, *Supella longipalpa*, *Tenebrio molitor*, ecology, Washington, United States.

Dekozlowski, S.J.; Bunting, D.L. II (1981) **A laboratory study on the thermal tolerance of four south-eastern stream insect species (Trichoptera, Ephemeroptera).** *Hydrobiologia.* 79(2): 141-145. ISSN: 0018-8158.
NAL Call Number: 410 H992
Descriptors: benthos, streams, Ephemeroptera, laboratory study, environmental factor, freshwater environment, temperature, tolerance, Trichoptera, ecology.

1980

Fuller, R.L.; Mckay, R.J. (1980) **Field and laboratory studies of net-spinning activity by Hydropsyche larve (Trichoptera: Hydropsychae).** *Canadian journal of zoology.* 58(11): 2006-2014. ISSN: 0008-4301.
NAL Call Number: 470 C16D
Descriptors: net construction behavior, water current, Hydropsychidae, insect migration, freshwater environment, photoperiod, temperature, weaving, Trichoptera, ethology.

1979

Bhaskaran, G.; Friedman, S.; Rodriguez, J.G. (1979) *Current topics in insect endocrinology and nutrition: a tribute to Gottfried S. Fraenkel.* Note: Proceedings of a symposium held during the annual meeting of the Entomological Society of America in Denver, Colo., Nov. 1979, vi, 362 pgs.: ill.; 26 cm. New York: Plenum Press, c1981.
NAL Call Number: QL495 E48 1979
Descriptors: physiology, Congresses, food, insect endocrinology, nutrition, proceedings.

Moth, I.T. (1979) **Laboratory energetics of larvae of *Sericostoma personatum* (Trichoptera).** *Holarctic ecology.* 2(1): 1-5.
NAL Call Number: QH540 H6
Descriptors: energy balance, food intake, streams, growth, laboratory study, environmental factor, freshwater environment, respiration, Trichoptera.

Vaughan, J.A.; Coombs, M.E. (1979) **Laboratory breeding of the European rabbit flea *Spilopsyllus cuniculi* (*dale*).** *Journal of hygiene.* 83(3): 521-530.
NAL Call Number: 449.8 J82
Descriptors: feeding, laboratory rearing, environmental factor, fecundity, blood sucking, Siphonaptera.

1978

Leppla, N.C.; Carlyle, S.L. (1978) **Modular rooms for modification of ambient laboratory environments.** *U S Department of Agriculture Technical Bulletin* (1576): 28-30. ISSN: 0082-9811.
NAL Call Number: 1 Ag84Te
Descriptors: rearing and breeding techniques, modular room system with environmental controls.

1977

Mac Kay, R.J. (1977) **Behavior of *Pycnopsyche* (Trichoptera: Limnephilidae) on mineral substrates in laboratory streams.** *Ecology.* 58(1): 191-195. ISSN: 0094-6621.
NAL Call Number: QH540 E32
Descriptors: selection, burrowing behavior, inorganic compound, artificial stream, granulometry, larva, freshwater environment, artificial substrate, tube house, ecology.

Sherberger, F.F.; Benfield, E.F.; Dickson, K.L.; Cairns, J. Jr. (1977) **Effects of thermal shocks on drifting aquatic insects. A laboratory simulation.** *Journal of the Fisheries Research Board of Canada.* 34(4): 529-536. ISSN: 0008-2686.
NAL Call Number: 442.9 C16J
Descriptors: Baetidae, shock, environment, experimental study, Hydropsychidae, larva, freshwater environment, temperature, ecology, Trichoptera.

1976

Mc Donald, I.C. (1976) **Ecological genetics and the sampling of insect populations for laboratory colonization.** *Environmental entomology.* 5(5): 815-820. ISSN: 0046-225X.
NAL Call Number: QL461 E532
Descriptors: sampling, terrestrial environment, insect population, ecology.

Mc Donald, I.C. (1976) **Population structure and the sampling of insects for laboratory colonization.** *Journal of the New York Entomological Society.* 84(3): 212-213. ISSN: 0028-7199.
NAL Call Number: 420 N48J
Descriptors: sampling, artificial rearing, terrestrial environment, population structure.

1975

Kettela, E.G. (1975) *Forest insects and tree diseases in national parks in the Maritime Provinces.* Fredericton. Canadian Forestry Service, Dept. of the Environment, 21 pgs., maps.
NAL Call Number: SD13.F65 No.54
Descriptors: miscellaneous forest insects, diseases, national parks, maritime provinces.

Lillehammer, A. (1975) **Norwegian stoneflies. IV. Laboratory studies on ecological factors influencing distribution.** *Norwegian journal of entomology.* 22(2): 99-108.
NAL Call Number: 421 N812
Descriptors: feeding, postembryonic development, environment, Europe, longevity, Norway, temperature, ecology, Plecoptera.

Biocontrol Related Resources

Drosophila

2002

Khyami-Horani, H. (2002) **Toxicity of *Bacillus thuringiensis* and *B. sphaericus* to laboratory populations of *Drosophila melanogaster* (Diptera: Drosophilidae).** *Journal of Basic Microbiology.* 42(2): 105-110. ISSN: 0233-111X.
NAL Call Number: QR1 Z4
Descriptors: insect pest assessment control and management, toxicology, Diptera, *Bacillus sphaericus*, biological control agent, spore, *Bacillus thuringiensis*, *Drosophila melanogaster*, fruit fly, laboratory populations, larva, Jordan.

1993

Prophetou-Athanasiadou, D.; Hodgson, P.J.; Kouloussis, N.; Jones, T.H. (1993) **Oviposition behavior of *Drosophila subobscura* and its parasitoid *Asobara tabida* in the laboratory.** *Entomologia Experimentalis et Applicata.* 67(3): 285-291. ISSN: 0013-8703.
NAL Call Number: 421 En895
Descriptors: egg laying behavior, nutrition, parasitology, physiology, Diptera, Fungi, Hymenoptera, Leguminosae, Lepidoptera, *Aphis gossypii*, *Heliothis virescens*, *Orius insidiosus*, *Schizaphis graminum*, biological control agent, fecundity, free water, longevity, nymphal diet.

Other Diptera

2002

Perrotey, S.; Madulo-Leblond, G.; Pesson, B. (2002) **Laboratory testing of the insect repellent KBR 3023 against *Phlebotomus duboscqi* (Diptera : Psychodidae).** *Parasitology Research.* 88(7): 712-713. ISSN: 0932-0113.
NAL Call Number: QL757 P377
Descriptors: microbiology, insect repellent KBR 3023, Bayrepel, Bayer, Germany, *Phlebotomus duboscqi*, laboratory evidence, phlebotomine sandfly sensitivity, tropical environment, field efficacy, mosquitos.

2001

Koveos, D.S. (2001) **Rapid cold hardening in the olive fruit fly *Bactrocera oleae* under laboratory and field conditions.** *Entomologia experimentalis et applicata.* 101(3): 257-263. ISSN: 0013-8703.

NAL Call Number: 421 En895
Descriptors: cold resistance, insect pest, olive plant, vegetal, survival, *Olea europaea*, Tephritidae, environmental factor, Diptera.

2000

Skovgard, H.; J.B. Jespersen (2000) **Seasonal and spatial activity of Hymenopterous pupal parasitoids (Pteromalidae and Ichneumonidae) of the house fly (Diptera: Muscidae) on Danish pig and cattle farms.** *Environmental entomology*. 29(3): 630-637. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Abstract: Two pig farms, two dairies, and a combined pig and dairy farm in Denmark were sampled weekly from April to December 1997 to determine the distribution and relative abundance of *Musca domestica l.* pupal parasitoids. Nine parasitoid species were collected in the study, including *Spalangia cameroni perkins*, *S. nigripes curtis*, *S. subpunctata forster*, *S. nigra latrielle*, *Muscidifurax raptor girault* and *sanders*, *Nasonia vitripennis* (*walker*), *Pachycrepoideus vindemiae* (*rondani*), *Urolepis rufipes* (*ashmead*), and *Phygadeuon fumator gravenhorst*. *S. nigra* had not previously been recorded as a parasitoid on *M. domestica* pupae in Denmark. Among the five farms, *S. cameroni* was the most abundant species collected indoors, whereas *M. raptor* dominated outdoors in the manure heaps. Maximum activity of parasitoids was observed in late summer, which corresponded well with peaks in temperature and fly density. *S. cameroni* and *M. raptor* were active from spring to fall, whereas the other species occurred more sporadic and in lower numbers. The overall rate of parasitism was low, ranging from 5.1 to 13.1% among the farms. Spatial distribution of the three most abundant species at indoor sites revealed that *M. raptor* primarily searches for fly pupae in the illuminated areas of the stable environment, whereas *S. cameroni* and *S. nigripes* were randomly distributed.
Descriptors: *Musca domestica*, parasitoids, parasites of insect pests, parasitism, population density, activity, phenology, spatial distribution, seasonal abundance, biological control agents, farms, cattle, Denmark.

1998

Collins, A.P. (1998) **Laboratory evaluation of the freshwater prawn, *Macrobrachium borellii*, as a predator of mosquito larvae.** *Aquatic Sciences*. 60(1): 22-27. ISSN: 1015-1621.
Descriptors: Diptera, Malacostraca, Crustacea, *Culex pipiens* larva, prey, *Macrobrachium borellii*, freshwater prawn, predator, hunting success, lentic environment, potential biological control, predation, behavioral biology.

Zahiri, N.; M.E. Rau (1998) **Oviposition attraction and repellency of *Aedes aegypti* (Diptera: Culicidae) to waters from conspecific larvae subjected to crowding, confinement, starvation, or infection.** *Journal of medical entomology*. 35(5): 782-787. ISSN: 0022-2585.
NAL Call Number: 421 J828
Abstract: As the biomass of *Aedes aegypti* (*l.*) larvae increased in relation to the volume

of rearing waters, oviposition attraction of these waters to conspecific, gravid females first rose to a peak and then declined. Further increases in biomass rendered waters strongly repellent. Comparable responses were elicited by a decrease in the volume of rearing waters or an increase in the relative size or number of mosquito larvae. Low volumes of water reduced oviposition attraction and increased repellency, whereas larger volumes increased attraction. Excessively large volumes diluted attraction to neutrality. Constraints imposed by the physical dimensions of the larval environment which interfered with the normal postural movements and behaviors of the larvae also induced repellency, independent of rearing volume. Titration of repellent waters revealed that infection with the digenean *Plagiorchis elegans* (*rudolphi*) generated the most powerful repellent effect, whereas crowding or starvation induced significantly weaker responses. At no time did dilution of repellent waters restore attractive properties. Repellents, even at minute concentrations, overrode attractants. The density-dependent action of oviposition attractants and repellents may help to maintain larval populations near optimal levels through their influence on recruitment. Oviposition repellency induced by sublethal infections with *P. elegans* may maintain population levels below the carrying capacity of the environment. Persistence of oviposition attraction and repellency varied inversely with temperature. The magnitude of the repellent effect induced by larvae appears to be a good indicator of their probability of survival and may be of selective significance. Repellency may deflect ovipositing females away from sites close to human habitation and may lead to new, and perhaps more effective, method, to control mosquitoes and the diseases they transmit.
Descriptors: *Aedes aegypti*, oviposition, attractants, deterrents, repellency, larvae, water, crowding, population density, density dependence, constraints, starvation, *Plagiorchis*, trematode infections, environmental temperature.

1996

Robacker, D.C.; D.S. Moreno; A.B. DeMilo (1996) **Attractiveness to Mexican fruit flies of combinations of acetic acid with ammonium/amino attractants with emphasis on effects of hunger.** *Journal of chemical ecology.* 22(3): 499-511. ISSN: 0098-0331.
NAL Call Number: QD415.A1J6
Abstract: Ammonium acetate was more attractive than other ammonium salts to Mexican fruit flies (*Anastrepha ludens*) in an orchard test. We hypothesized that acetic acid enhanced the attractiveness of ammonia in the orchard test and that acetic acid may similarly enhance attractiveness of AMPu, an attractant consisting of a mixture of ammonium bicarbonate or ammonium carbonate, methylamine HCl, and putrescine. In laboratory experiments, acetic acid was attractive to flies deprived of either yeast hydrolysate or both sugar and yeast hydrolysate but not to flies fed both sugar and yeast hydrolysate. AMPu/acetic acid combinations were more attractive than AMPu alone to flies deprived of both sugar and yeast hydrolysate but not to flies fed sugar, regardless of yeast hydrolysate deprivation status. Acetic acid is the first attractant found that has become more attractive with both sugar and protein deprivation in studies with *A. ludens*. It is also the first that has enhanced the attractiveness of another attractant type. In orchard tests, yellow sticky panels baited with either AMPu or 17 mg of acetic acid were at least six times more attractive than unbaited panels. However, panels baited with both acetic acid (17-68 mg) and AMPu were less attractive than AMPu alone. These results

differed from the laboratory data in which combinations were never less attractive than AMPu alone.
Descriptors: *Anastrepha ludens*, attractants, acetic acid, ammonium compounds, amino compounds, hunger, sugar, protein, biocontrol.

1994

Urabe, K.I.; Sekijima, Y.; Nakazawa, K. (1994) **Study of the natural predators of a mosquito *Culex tritaeniorhynchus* in rice field areas by using precipitin tests: 1. Laboratory tests for the detection of the antigens specific to *Culex tritaeniorhynchus* extract.** *Japanese Journal of Sanitary Zoology.* 45(1): 43-51. ISSN: 0424-7086.
NAL Call Number: QL99 E3
Descriptors: economic entomology, immune system, chemical coordination and homeostasis, nutrition, pest assessment control and management, physiology, Diptera, *Culex tritaeniorhynchus*, biological control, electrosyneresis, immunological method, environmental biology, nutritional status and methods, immunology and immunochemistry, pesticides, herbicides, comparative and experimental morphology, pathology.

1993

Quednau, F.W. (1993) **Reproductive biology and laboratory rearing of *Ceranthia samarensis* (*villeneuve*) (Diptera: Tachinidae), a parasitoid of the gypsy moth, *Lymantria dispar* (*l.*).** *Canadian Entomologist.* 125(4): 749-759. ISSN: 0008-347X.
NAL Call Number: 421 \b C16
Descriptors: light, temperature, diapause, mating, behavior, pests, beneficial insects, natural enemies, forest trees, forest pests, hosts, parasitoids, biology, reproduction, broadleaves, agricultural entomology, *Ceranthia samarensis*, Lepidoptera, Tachinidae, Diptera, *Lymantria dispar*, *Quercus rubra*, insect pests, silviculture, biological control, moth reproduction and development.

1992

Andreadis, T.G.; Gere, M.A. (1992) **Laboratory evaluation of *Acanthocyclops vernalis* and *Diacyclops bicuspidatus thomasi* (Copepoda: Cyclopidae) as predators of *Aedes canadensis* and *Aedes stimulans* (Diptera: Culicidae).** *Journal of Medical Entomology.* 29(6): 974-979. ISSN: 0022-2585.
NAL Call Number: 421 J828
Descriptors: ecology, economic entomology, freshwater ecology, nutrition, insect pest assessment control and management, physiology, public health, vector biology, Copepoda, Diptera, *Acanthocyclops vernalis*, *Aedes canadensis*, *Aedes stimulans*, *Diacyclops bicuspidatus thomasi*, age, biological control, environmental biology, general dietary studies, developmental biology, vector control, pathology.

MacCollom, G.B.; C.R. Lauzon; R.W. Weires Jr.; A.A. Rutkowski (1992) **Attraction of adult apple maggot (Diptera: Tephritidae) to microbial isolates.** *Journal of economic*

entomology. 85(1): 83-87. ISSN: 0022-0493.
NAL Call Number: 421 J822
Abstract: Eight bacterial species isolated from apple foliage were evaluated for attractiveness to adult apple maggot flies, *Rhagoletis pomonella* (*walsh*) in the laboratory. None elicited a strong response from the adult apple maggot flies. Another, previously unknown bacterium was isolated internally from the adult fly,, from under fresh oviposition sites on field collected fruit, and from the decaying flesh of maggot infested apples. Efforts to identify the bacterium indicated that it is similar to *Enterobacter agglomerans*, but inconsistencies in biochemical tests and colonial morphology were shown. The bacterium, or volatiles produced by the bacterium, is attractive to foraging apple maggot flies in the orchard environment, and significantly increases fly captures on Ladd apple maggot traps with an apple volatiles attractant.
Descriptors: *Malus pumila*, orchards, *Rhagoletis pomonella*, bacteria, *Enterobacter agglomerans*, insect attractants and traps, volatile compounds, Nova Scotia.

Mangan, R.L.; Moreno, D.S. (1992) **Interaction of wild males and laboratory-adapted females of the Mexican fruit fly (Diptera: Tephritidae) in natural habitats.** *Environmental Entomology*. 21(2): 294-300. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: mating behavior, insect pests, cold resistance, sterile insect release, biocontrol, Diptera, Tephritidae, *Anastrepha ludens*, Mexico, North America, pest and parasite management, control measures.

Rodriguez, M.L.; Torres, R.; Casillas, S.; Galan, L.; Gonzalez, E. (1992) **Laboratory and field evaluation of commercial and locally prepared formulations of *Bacillus thuringiensis var. israelensis* and *Bacillus sphaericus* on Culicidae of northeastern Mexico.** *Journal of the American Mosquito Control Association*. 8(3): 312-313. ISSN: 8756-971X. Note: Conference/Meeting: 58th Annual Meeting of the American Mosquito Control Association, Corpus Christi, Texas, USA, March 17, 1992.
NAL Call Number: QL536 J686
Descriptors: methods, pest assessment control and management, vector biology, Diptera, *Aedes aegypti*, *Bacillus sphaericus*, *Bacillus thuringiensis var. israelensis*, *Culex quinquefasciatus*, biological control, materials and apparatus, environmental biology, bacteriology, disinfection and vector control, disease vectors.

Toma, T.; Miyagi, I. (1992) **Laboratory evaluation of *Toxorhynchites splendens* (Diptera: Culicidae) for predation of *Aedes albopictus* mosquito larvae.** *Medical and Veterinary Entomology*. 6(3): 281-289. ISSN: 0269-283X.
NAL Call Number: RA639.M44
Descriptors: ecology, economic entomology, pest assessment control and management, physiology, public health, allied medical sciences, vector biology, Diptera, *Aedes albopictus*, *Toxorhynchites splendens*, biological control, cannibalism, oviposition, behavioral biology, insect behavior, environmental biology, developmental biology, embryology, disinfection and vector control, comparative and experimental morphology, pathology, developmental biology, morphogenesis.

1991

Buckingham, G.R.; Okrah, E.A.; Christian-Meier, M. (1991) **Laboratory biology and host range of *Hydrellia bacciunasi* (Diptera: Ephydridae).** *Entomophaga.* 36(4): 575-586. ISSN: 0013-8959.
NAL Call Number: 421 En835
Descriptors: laboratory study, host range and plant, weed, biological control, phytophagous, larva, duration, development, fecundity, longevity, freshwater environment, Florida, Ephydridae, United States, North America, Diptera.

1990

Robacker, D.C.; D.S. Moreno; D.A. Wolfenbarger (1990) **Effects of trap color, height, and placement around trees on capture of Mexican fruit flies (Diptera: Tephritidae).** *Journal of economic entomology.* 83(2): 412-419. ISSN: 0022-0493.
NAL Call Number: 421 J822
Abstract: Green and yellow were the most attractive colors to male and female Mexican fruit flies, *Anastrepha ludens* (*loew*), followed by amber, orange, and fluorescent yellow, on colored rectangles in the laboratory and as colored solutions in McPhail traps in the field. The most attractive wavelengths were in the green and yellow spectral regions from 500-580 nm. Black, red, blue, and white were not more attractive than colorless control traps. Attractiveness of red, orange, and yellow doubled from spring to autumn in the field, whereas attractiveness of green and amber did not change. Yeast hydrolysate was significantly more attractive than any of the colors. Combinations of green or yellow with yeast hydrolysate in McPhail traps did not enhance the attractiveness of yeast hydrolysate. More flies were captured at 1 and 2 m above the ground than at 0.1 or 3 m (tree tops). More flies were captured on the north side of trees than on the south side, whereas east and west were not significantly different from each other.
Descriptors: citrus, *Anastrepha ludens*, insect traps, color as an attractant, height, placement, light wavelengths, Texas.

Van Der Linde, T.C.; Hewitt, P.H.; Nel, A.; Van Der Westhuizen, M.C. (1990) **The influence of different constant temperatures and saturation deficits on the survival of adult *Culex* (*culex*) *theileri theobald* (Diptera: culicidae) in the laboratory.** *Journal of the Entomological Society of Southern Africa.* 53(1): 57-63. ISSN: 0013-8789.
NAL Call Number: 420 En86
Descriptors: life history, environmental factor, humidity, temperature, feeding, saturation, biological control.

1989

Buckingham, G.R.; Okrah, E.A.; Thomas, M.C. (1989) **Laboratory host range tests with *Hydrellia pakistanae* (Diptera: Ephydridae), an agent for biological control of *Hydrilla verticillata* (Hydrocharitaceae).** *Environmental entomology.* 18(1): 164-171. ISSN: 0046-225X.
NAL Call Number: QL461.E532

Descriptors: insect plant relation, host range testing, host plant selection, weed, natural enemy introduction, phytophagous, freshwater environment, interspecific relation, Diptera.

1988

Lacoursiere, J.O.; Charpentier, G. (1988) **Laboratory study of the influence of water temperature and pH on *Bacillus thuringiensis* var. *israelensis* efficacy against black fly larvae (Diptera: Simuliidae).** *Journal of the American Mosquito Control Association.* 4(1): 64-72. ISSN: 8756-971X.
NAL Call Number: QL536 J686
Descriptors: entomopathogens, microbial pesticides, pathogenicity, environmental factors, hosts, biological control agents, Diptera, *Simulium decorum*, *Bacillus thuringiensis*, *Prosimulium mixtum*, *Prosimulium fuscum*, *Bacillus thuringiensis* subsp. *israelensis*, North America, Canada, Quebec, America, medical and veterinary entomology records, insect pest management, parasites, vectors.

Miura, T.; Takahashi, R.M. (1988) **A laboratory study of predation by damselfly nymphs, *Enallagma civile*, upon mosquito larvae, *Culex tarsalis*.** *Journal of the American Mosquito Control Association.* 4(2): 129-131. ISSN: 8756-971X.
NAL Call Number: QL536 J686
Descriptors: predator-prey relation, predatory behavior, population density, biological control, California, laboratory study, freshwater environment, vector, *Culex tarsalis*, United States, Culicidae, Diptera.

1987

Nnakumusana, E.S. (1987) **The pathogenicity of two isolates of *Pythium* spp. to mosquito larvae in the laboratory.** *Insect Science and its Application.* 8(1): 21-24. ISSN: 0191-9040.
NAL Call Number: QL461.I57
Descriptors: pathogens, natural enemies, environmental factors, entomogenous fungi, pathogenicity, hosts, mosquito nets, *Eretmopodites*, Diptera, *Aedes aegypti*, *Culex quinquefasciatus*, *Toxorhynchites brevipalpis*, *Aedes africanus*, *Aedes simpsoni*, *Anopheles gambiae*, Pythium, Culicidae, Uganda, Africa, Peronosporales, Mastigomycotina, Eumycota, East Africa, Africa South of Sahara, medical and veterinary entomology records, control measures, biological control, parasites vectors.

Santamarina Mijares, A.; Gonzalez Broche, R. (1987) **Efecto de diversos photoperiods en la infestación de los *ross* y del forjador, 1976 del *culicivorax* de *Romanomermis* (Rhabditida: Mermithidae) en las larvas del quinquefasciatus del mosquito del mosquito dice, 1823 condiciones inferiores del laboratorio. [Effect of different photoperiods on the infestation of *Romanomermis culicivorax ross* and *smith*, *1976* (Rhabditida: Mermithidae) in larvae of the mosquito *Culex quinquefasciatus say, 1823* under laboratory conditions.]** *Revista Cubana de Medicina Tropical.* 39(1): 63-66. ISSN: 0375-0760. Note: In Spanish.

Descriptors: entomophilic nematodes, infectivity, photoperiod effects, natural enemies, nematology, entomopathogens, Diptera, Culicidae, Nematoda, Mermithidae, *Culex quinquefasciatus*, *Romanomermis culicivorax*, parasitic nematodes, parasites, vectors, biological control.

1985

Nnakumusana, E.S. (1985) **Laboratory infection of mosquito larvae by entomopathogenic fungi with particular reference to *Aspergillus parasiticus* and its effects on fecundity and longevity of mosquitoes exposed to conidial infections in larval stages.** *Current science.* 54(23): 1221-1228. ISSN: 0011-3891.
NAL Call Number: 475 Sci23
Descriptors: entomopathogen, pathogenicity, Diptera, temperature, fecundity, longevity, larva, infection, laboratory study, Culicidae, blood sucking, environmental factor, biological control, *Aedes aegypti*, *Anopheles gambiae*, *Culex fatigans*, *Aspergillus parasiticus*, Thallophyta, *Fungi imperfecti*.

1984

Friederich, P. (1984) **Temperature-induced dormancy in laboratory and wild eggs of the floodwater mosquito *Aedes vexans meigen* (Diptera: Culicidae).** *Zeitschrift fuer angewandte Zoologie.* 71(3): 353-368. ISSN: 0044-2291.
NAL Call Number: 449.8 Z36
Descriptors: Diptera, developmental arrest, dormancy, temperature effects, embryonic development, Culicidae, *Aedes vexans*.

Majori, G.; Ali, A. (1984) **Laboratory and field evaluations of industrial formulations of *Bacillus thuringiensis serovar. israelensis* against some mosquito species of Central Italy.** *Journal of invertebrate Pathology.* 43(3): 316-323. ISSN: 0022-2011.
NAL Call Number: 421 J826
Descriptors: Diptera, vector, microbial insecticide, formulation, therapeutic efficiency, Italy, larva, freshwater environment, Culicidae, microbiological control, bacteria, entomopathogen, Europe, *Culex pipiens*, *Aedes caspius*, *Aedes detritus*.

1983

Russell, R.C.; Panter, C.; Whelan, P.I. (1983) **Laboratory studies of the pathogenicity of the mosquito fungus *Culicinomyces* to various species in their natural waters.** *General and applied entomology : the journal of the Entomological Society of Australia (N.S.W.).* 15: 53-63. ISSN: 0158-0760.
NAL Call Number: 423.92 En84
Descriptors: Diptera, fungi, entomopathogen, microbiological control, therapeutic efficiency, underwater environment, Australia, Oceania, *Culex*, *Anopheles*, *Aedes*, Thallophyta.

Sweeney, A.W.; Roberts, D.W. (1983) **Laboratory evaluation of the fungus *Culicinomyces***

***clavosporus* for control of blackfly (Diptera: Simuliidae) larvae.** *Environmental entomology.* 12(3): 774-778. ISSN: 0046-225X.
NAL Call Number: QL461 E532
Descriptors: Diptera, fungi, entomopathogen, pathogenicity, laboratory study, screening test, Simuliidae, blood sucking, freshwater environment, Thallophyta.

1982

Jaronski, S.T.; Axtell, R.C. (1982) **Effects of organic water pollution on the infectivity of the fungus *Lagenidium giganteum* (Oomycetes: Lagenidiales) for larve of *Culex quinquefasciatus* (Diptera: Culicidae): field and laboratory evaluation.** *Journal of medical entomology.* 19(3): 255-262. ISSN: 0022-2585.
NAL Call Number: 421 J828
Descriptors: microbiological control, water pollution, fungal infectivity, environment, *Lagenidium giganteum.*

1981

Bailey, D.L.; Focks, D.A.; Cameron, A.L. (1981) **Effects of *Toxorhynchites rutilus rutilus (coquillett)* larvae on production of *Aedes aegypti* adults in laboratory tests.** *Mosquito News.* 41(3): 522-527. ISSN: 0027-142X.
NAL Call Number: 421 M85
Descriptors: larva, entomophagous, biological control, *Aedes aegypti*, Culicidae, Diptera, freshwater environment, predator-prey relation, *Toxorhynchites rutilus*, artificial rearing.

Ignoffo, C.M.; Garcia, C.; Kroha, M.J.; Fukuda, T.; Couch, T.L. (1981) **Laboratory tests to evaluate the potential efficacy of *Bacillus thuringiensis var. israelensis* for use against mosquitoes.** *Mosquito News.* 41(1): 85-93. ISSN: 0027-142X.
NAL Call Number: 421 M85
Descriptors: *Aedes aegypti*, *Bacillus thuringiensis*, Culicidae, Diptera, entomopathogen, laboratory study, environmental factors, blood sucking, microbial insecticide, microbiological control, pathogenicity, vector, insect pest and disease control.

1980

Padgett, P.D.; Focks, D.A. (1980) **Laboratory observations on the predation of *Toxorhynchites rutilus rutilus* on *Aedes aegypti* (Diptera: Culicidae).** *Journal of medical entomology.* 17 (5): 466-472. ISSN: 0022-2585.
NAL Call Number: 421 J828
Descriptors: *Aedes aegypti*, predatory behavior, Culicidae, population density, Diptera, entomophagous, larva, freshwater environment, predator, developmental stage, *Toxorhynchites rutilus*, vector, behavioral study.

Coleoptera

2002

Lee, D.W.; Choo, H.Y.; Kaya, H.K.; Lee, S.M.; Smitley, D.R.; Shin, H.K.; Park, C.G. (2002) **Laboratory and field evaluation of Korean entomopathogenic nematode isolates against the oriental beetle *Exomala orientalis* (Coleoptera: Scarabaeidae).** *Journal of Economic Entomology.* 95(5): 918-926. ISSN: 0022-0493.
NAL Call Number: 421 J822
Descriptors: economic entomology, pesticides, Coleoptera, Nematoda, Aschelminthes, Helminthes, *Exomala orientalis*, *Heterorhabditis*, entomopathogen, *Steinernema carpocapsae*, *Steinernema glaseri*, *Steinernema longicaudum*, white grub control.

2001

Saska, P.; Jarosik, V. (2001) **Laboratory study of larval food requirements in nine species of *Amara* (Coleoptera: Carabidae).** *Plant Protection Science.* 37(3): 103-110. ISSN: 1212-2580.
NAL Call Number: SB599 R37
Descriptors: economic entomology, nutrition, diets, environmental biology, Coleoptera, Cruciferae, *Amara aenea*, biological control potential, larval food requirements, *Amara familiaris*, *Amara lunicollis*, *Amara montivaga*, *Amara nitida*, *Amara saphyrea*, *Amara similata*, *Amara spreta*, *Amara tibialis*, *Capsella bursa-pastoris*, *Stellaria media*, weed population biology.

1999

Blossey, B.; T.R. Hunt (1999) **Mass rearing methods for *Galerucella calmariensis* and *G. pusilla* (Coleoptera: Chrysomelidae), biological control agents of *Lythrum salicaria* (Lythraceae).** *Journal of economic entomology.* 92(2): 325-334. ISSN: 0022-0493.
NAL Call Number: 421 J822
Abstract: Purple loosestrife, *Lythrum salicaria l.*, an invasive Eurasian perennial, is degrading wetlands across temperate North America. Because conventional control methods have proven ineffective, current emphasis is on the introduction and release of host-specific biological control agents. To increase the availability of control agents for distribution and thus the potential for faster control, mass rearing techniques for 2 leaf beetles, *Galerucella calmariensis l.* and *G. pusilla duftschmidt*, were developed under greenhouse and field conditions. To evaluate the success of various rearing techniques on the number of beetles produced and the effect of these methods on offspring quality, female fecundity, larval development, and adult survival were monitored. Survival of adults maintained at 4 degrees C was approximately equal to 60% and was independent of the type of material used for storage, duration of overwintering, and number of beetles per container. Survival rates increased with increasing numbers of dry stems offered as an overwintering substrate. Females in smaller cages had significantly higher oviposition rates, and with an increase in the number of beetles per cage, female fecundity doubled.

Continuous rearing in the greenhouse reduced female fecundity. Allowing beetles to overwinter significantly improved fecundity and rearing efficiency, independent of whether beetles overwintered in a controlled environment or in the field. Field rearings consistently produced 2-5 times more offspring with higher survival than greenhouse rearings.
Descriptors: *Galerucella*, *Lythrum salicaria*, biological control agents, weed control, mass rearing, fecundity, oviposition, biological development, survival, overwintering.

1997

Prazak, R.A. (1997) **Laboratory evaluation of *Beauveria bassiana* (*bals.*) *vuill.* (Deuteromycotina: Hyphomycetes) against *Trypodendron lineatum oliv.* (Coleoptera: Scolytidae).** *Zeitschrift fuer Pflanzenkrankheiten und Pflanzenschutz.* 104(5): 459-465. ISSN: 0340-8159.
NAL Call Number: 464.8 Z3
Descriptors: age, temperature effect, treatment efficiency, air humidity, pest management, microbiological control, *Beauveria bassiana*, *Trypodendron lineatum*, laboratory study, *Fungi imperfecti*, Thallophyta, Scolytidae, Coleoptera, entomology, environmental factor, forestry, biological control of pest, entomopathogen, *Silvicolous*.

1996

Tauber, M.J.; Tauber, C.A.; Nechols, J.R. (1996) **Life history of *Galerucella nymphaeae* and implications of reproductive diapause for rearing univoltine chrysomelids.** *Physiological Entomology.* 21(4): 317-324. Notes: 22 ref.
NAL Call Number: QL461.P5
Descriptors: diapause, photoperiodicity, temperature, *Galerucella*, life cycle, seasons, periodicity, biological control organisms, environmental factors, rearing techniques, United Kingdom, British Isles, Chrysomelidae, Coleoptera, dormancy, environmental factors, Europe, light regimes.

Vasconcelos, S.D.; T. Williams; R.S. Hails; J.S. Cory (1996) **Prey selection and baculovirus dissemination by carabid predators of Lepidoptera.** *Ecological entomology.* 21(1): 98-104. ISSN: 0307-6946.
NAL Call Number: QL461.E4
Abstract: 1. The interaction between coleopteran predators and baculovirus-infected larvae was studied in the laboratory and the field in order to assess the potential role of predators in the dissemination of a nucleopolyhedrovirus (NPV). 2. Preference tests using three carabid species, *Harpalus rufipes de geer*, *Pterostichus melanarius illiger*, and *Agonum dorsale pont.* showed no evidence of discrimination between healthy and diseased larvae of the cabbage moth *Mamestra brassicae l.* (Lepidoptera: Noctuidae) as prey items. 3. Virus infectivity was maintained after passage through the predator's gut. NPV mortality ranged from 97% to 20% when test larvae were exposed to faeces collected immediately after and 15 days post-infected meal respectively. 4. The potential for transfer of inoculum in the environment was estimated in the laboratory by soil bioassay. Carabids continuously passed infective virus to the soil for at least 15 days after

feeding on infected larvae. 5. Field experiments showed that carabids which had previously fed on diseased larvae transferred sufficient virus to the soil to cause low levels of mortality in larval populations of the cabbage moth at different instars. Descriptors: *Mamestra brassicae*, larvae, nuclear polyhedrosis viruses, disease transmission, Carabidae, predators, predator prey relationships, infectivity, mortality, feces, soil, disease vectors, England.

1995

Chandler, L.D.; G.R. Sutter; L. Hammack; W.D. Woodson (1995) **Semiochemical insecticide bait management of corn rootworms.** *Clean water, clean environment, 21st century team agriculture, working to protect water resources conference proceedings.* 1: 29-32. ISBN: 0929355601. Notes: March 5-8, 1995, Kansas City, Missouri /. St. Joseph, Mich.: ASAE, c1995.
NAL Call Number: TD365.C54 1995
Descriptors: *Diabrotica barberi*, *Diabrotica virgifera*, carbaryl, semiochemicals, cucurbitacins, baits, *Zea mays* corn, fields, bait traps, South Dakota, Coleoptera.

1994

Hattingh, V.; Samways, M.J. (1994) **Physiological and behavioral characteristics of *Chilocorus* spp. (Coleoptera: Coccinellidae) in the laboratory relative to effectiveness in the field as biocontrol agents.** *Journal of Economic Entomology.* 87(1): 31-38. ISSN: 0022-0493.
NAL Call Number: 421 J822
Descriptors: ecology, economic entomology, pest assessment control and management, physiology, Coleoptera, Rutaceae, *Chilocorus bipustulatus*, *Chilocorus cacti*, *Chilocorus distigma*, *Chilocorus infernalis*, *Chilocorus nigritus*, *Chilocorus simoni*, biological control, behavioral biology, biocontrol agent effectiveness.

Roberts, S.J.; Maddox, J.V.; Armbrust, E.J. (1994) **A laboratory infection of alfalfa weevil, *Hypera postica* (Coleoptera: Curculionidae), larvae with the fungal pathogen *Zoophthora phytonomi* (Zygomycetes: Entomophthoraceae).** *Great Lakes Entomologist.* 27(1): 19-21. ISSN: 0090-0222.
NAL Call Number: QL461 M5
Descriptors: development, ecology, economic entomology, infection, pathology, Coleoptera, *Fungi imperfecti* or *deuteromycetes*, *Phycomycetes*, *Hypera postica*, *Zoophthora phytonomi*, USA, biological control agent, resting spore, environmental and developmental biology, embryology, morphogenesis, fungal pathogen.

1993

Blumberg, D.; M. Kehat; S. Goldenberg; R.J. Bartelt; R.N. Williams (1993) **Responses to synthetic aggregation pheromones, host-related volatiles, and their combinations by *Carpophilus* spp. (Coleoptera: Nitidulidae) in laboratory and field tests.** *Environmental entomology.* 22(4): 837-842. ISSN: 0046-225X.

NAL Call Number: QL461.E532
Abstract: The effect of different aggregation pheromones on attraction of *Carpophilus hemipterus* (*l.*), *C. mutilatus erichson*, and *C. humeralis* (*f.*) was demonstrated in olfactometer and field trials in Israel. Aggregation pheromones act as synergists to attract *Carpophilus* spp. to host volatiles. Captures in traps baited with the pheromone-host volatiles combinations were higher than in traps baited with host volatiles alone. *Carpophilus* spp. aggregation pheromones are not entirely species-specific, and pheromones belonging to one species may also enhance attraction of other species. This cross-attraction is not surprising because congeners do have pheromone components in common. Thus, pheromones of *C. lugubris murray* and *C. freemani dobson* enhanced attraction of *C. hemipterus* to host volatiles, whereas *C. humeralis* attraction to host volatiles was enhanced by the pheromones of *C. hemipterus* and *C. lugubris*. *C. mutilatus* exhibited a high degree of activity to its own pheromone. Aggregation pheromones of *Carpophilus* spp. do not have any effect on *Haptoncus luteolus* (*erichson*). The possibility of using host volatiles-pheromone combinations for monitoring and perhaps even for control of these pests (by mass-trapping or disruption of egg laying and mating) appears very promising.
Descriptors: *Carpophilus hemipterus*, *Carpophilus mutilatus*, *Urophorus humeralis*, bait traps, aggregation pheromones, Israel.

1992

Bellows, T.S., Jr.; Paine, T.D.; Gerling, D. (1992) **Development, survival, longevity, and fecundity of *Clitostethus arcuatus* (Coleoptera: Coccinellidae) on *Siphoninus phillyreae* (Homoptera: Aleyrodidae) in the laboratory.** *Environmental Entomology.* 21(3): 659-663. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: temperature, beneficial insects, natural enemies, pests, predators, biology, environmental factors, agricultural entomology, *Clitostethus arcuatus*, Coleoptera, *Siphoninus phillyreae*, California, USA, Israel.

Grodowitz, M.J.; Lloyd, E.P.; McKibben, G.H. (1992) **Comparison of feeding and olfactory behaviors between laboratory-reared and overwintered native boll weevils (Coleoptera: Curculionidae).** *Journal of Economic Entomology.* 85(6): 2201-2210. ISSN: 0022-0493.
NAL Call Number: 421 J822
Descriptors: agronomy, agriculture, behavior, climatology, ecology, economic entomology, physiology, reproductive system, sense organs, sensory reception, Coleoptera, *Anthonomus grandis grandis*, biological control, crop damage, field-release program, insect control significance, behavioral biology, environmental biology, bioclimatology and biometeorology, biochemistry.

Lance, D.R.; G.R. Sutter (1992) **Field tests of a semiochemical-based toxic bait for suppression of corn rootworm beetles (Coleoptera: Chrysomelidae).** *Journal of economic entomology.* 85(3): 967-973. ISSN: 0022-0493.
NAL Call Number: 421 J822
Abstract: A semiochemical-based toxic bait for adult *Diabrotica virgifera virgifera*

leconte and *D. barberi smith* and *lawrence* was broadcast over three plots (1-3 ha) of maize, *Zea mays l.* The bait contained all insecticide (0.3% carbaryl), a feeding stimulant (cucurbitacin), and several nonpheromonal volatile attractants (totaling 0.5% of the formulation) in a dry, bran-based carrier. Bait was applied at 7-14 kg/ha (20-40 g [AI] carbaryl/ha). Relative to paired plots that were not treated with bait, numbers of *D. v. virgifera* and *D. barberi* counted on maize plants were reduced 77-85% and 55-92%, respectively, 48 h after bait applications. Likewise, relative numbers of *D. v. virgifera* and *D. barberi* captured on unbaited yellow sticky traps declined 58-91% and 67-88%, respectively, after applications of bait. Numbers of dead beetles on the ground 24 or 48 h after applications were roughly comparable to reductions in numbers of live beetles counted on plants. Activity of the bait was short-lived in the field, and populations of *Diabrotica* beetles in treated plots generally returned to near pretreatment levels within 1-2 wk after applications of bait. Although formulations must be improved to enhance activity and longevity, results of this study indicate that semiochemical-based baits for *Diabrotica* beetles are a potential tool for greatly reducing the amount of insecticide applied in maize production systems.
Descriptors: *Zea mays*, *Diabrotica barberi*, *Diabrotica virgifera*, biocontrol, baits, carbaryl, cucurbitacins, insect attractants, semiochemicals, sticky traps, toxicity, South Dakota.

Yeh, T.; Alm, S.R. (1992) **Effects of entomopathogenic nematode species, rate, soil moisture, and bacteria on control of Japanese beetle (Coleoptera: Scarabaeidae) larvae in the laboratory.** *Journal of Economic Entomology.* 85(6): 2144-2148. ISSN: 0022-0493.
NAL Call Number: 421 J822
Descriptors: ecology, economic entomology, horticulture, infection, parasitology, pathology, physiology, soil science, bacteria, Coleoptera, Lepidoptera, Nematoda, Aschelminthes, Helminthes, *Galleria mellonella*, *Heterorhabditis bacteriophora*, *Heterorhabditis heliothidis*, *Popillia japonica*, *Steinernema bibionis*, *Steinernema carpocapsae*, *Steinernema feltiae*, *Steinernema glaseri*, *Xenorhabdus luminescens*, *Xenorhabdus nematophilus*, *Xenorhabdus poinarii*, biological control, mortality, control of turf pests, environmental biology, necrosis.

1991

Cox, P.D.; W.E. Parish (1991) **Effects of refuge content and food availability on refuge-seeking behavior in *Cryptolestes ferrugineus* (*stephens*) (Coleoptera: Cucujidae).** *Journal of stored products research.* 27(2): 135-139. ISSN: 0022-474X.
NAL Call Number: 421 J829
Abstract: The effects of the contents of the refuge and the presence of food in the arena on refuge-seeking behavior in two strains of *Cryptolestes ferrugineus* (*stephens*) was investigated in the laboratory by confining adults in 21 cm dia arenas containing a central refuge. Some beetles were recorded in the refuges even when they contained only glass balls, although considerably fewer than when they contained whole wheat grains of flour. This suggests that a refuge retains some attraction for beetles even when food is absent, perhaps by providing physical contact around the insect's body. The addition of wheat or flour to the arena also reduced the numbers of beetles recorded in the refuges. Results were less clear-cut for a strain of *C. ferrugineus* that had been reared in the laboratory for

over 25 yr than for a strain more recently obtained from the natural storage environment. These results are discussed in relation to the importance of insect behavior in laboratory bioassays and control in grain stores.
Descriptors: flour mills, wheat flour, *Cryptolestes ferrugineus*, behavior, food supply, laboratory tests, shelter, stored products pests, biocontrol, England.

Krueger, S.R.; M.G. Villani; J.P. Nyrop; D.W. Roberts (1991) **Effect of soil environment on the efficacy of fungal pathogens against scarab grubs in laboratory bioassays.** *Biological control: theory and applications in pest management.* 1(3): 203-209. ISSN: 1049-9644.
NAL Call Number: SB925.B5
Descriptors: *Popillia japonica*, parasites of insect pests, *Metarhizium anisopliae*, *Beauveria brongniartii*, soil fungi, soil temperature and water, mortality, Coleoptera grubs.

Rochat, D.; V.A. Gonzalez; D. Mariau; G.A. Villanueva; P. Zagatti (1991) **Evidence for male-produced aggregation pheromone in American palm weevil, *Rhynchophorus palmarum* (*l.*) (Coleoptera: Curculionidae).** *Journal of chemical ecology.* 17(6): 1221-1230. ISSN: 0098-0331.
NAL Call Number: QD415.A1J6
Abstract: Field trapping of the American palm weevil (APW), *Rhynchophorus palmarum*, showed that the combination of caged male APWs and palm stem was much more attractive to APWs of both sexes than palm stem alone. Caged female APWs did not enhance the attractiveness of the palm. Caged APWs without palm stem were not attractive. Virgin laboratory-bred males were highly attractive to APWs of both sexes in a two-choice pitfall olfactometer, whereas virgin laboratory-bred females were not. Adsorbent-trapped volatiles from virgin laboratory-bred males reproduced the effect of living males, giving evidence for a male-produced aggregation pheromone in this species. Wild-mated APWs of both sexes were as responsive to the aggregation pheromone as virgin laboratory-bred APWs. This is the first record of chemical communication in this species. These results have prompted investigations into the chemical identification of the aggregation pheromone.
Descriptors: *Rhynchophorus palmarum*, males, aggregation pheromones, insect traps, field tests, bioassays, biological control, chemical communication.

Sedlacek, J.D.; Barney, R.J.; Price, B.D.; Siddiqui, M. (1991) **Effect of several management tactics on adult mortality and progeny production of *Sitophilus zeamais* (Coleoptera: Curculionidae) on stored corn in the laboratory.** *Journal of Economic Entomology.* 84(3): 1041-1046. ISSN: 0022-0493.
NAL Call Number: 421 J822
Descriptors: insect pests, stored corn, temperature, moisture, control, maize, insecticides, effects, malathion (CAS Registry Number: 121-75-5), environmental factors, biodeterioration, *Sitophilus zeamais*, *Zea mays*, organothiophosphate.

Shimane, T. (1991) **[Method for successive mass-rearing of the yellow-spotted longicorn beetle, *Psacothea hilaris pascoe* (Coleoptera: Cerambycidae), on artificial diets.]** *Bulletin of the National Institute of Sericultural and Entomological Science.* (2): 65-112.

ISSN: 0915-2652. Notes: 26 tables; 8 fig.; 36 ref., In Japanese.
NAL Call Number: SF541.S26
Abstract: The yellow-spotted longicorn beetle, *Psacothea hilrais pascoe*, is one of the insects which cause serious damage to mulberry trees in Japan. Therefore, it is important to control the pest effectively. It had been reported that the adult beetle was specifically infected with an entomogenous fungus, *Beauveria brongniartii* (=*B.tenella*) (*sacc.*) *petch*. Therefore it was suggested that this fungus could be utilized for the control of the pest. In order to promote studies on microbial control, it is necessary to use a large number of insects for the development of a bioassay. This paper reports on the development of a method for mass-rearing of the yellow-spotted longicorn beetle by using artificial diets for young silkworm larvae. The insect could be reared over successive generations in the laboratory to obtain a large number of insects for use in various experiments, after the effects of some of the environmental rearing conditions on the growth and development of the insect were investigated.
Descriptors: *Morus*, Cerambycidae, mass rearing, compound feeds, photoperiodicity, growth control, Coleoptera, environmental factors, feeds, light regimes, lighting, Moraceae, rearing techniques.

1990

Haubruge, E.; Gaspar, C. (1990) **Laboratory determination of areas favourable to the development of populations of the larger grain borer, *Prostephanus truncatus* (*horn*), in Africa.** *Agronomie Tropicale.* 45(4): 251-258. ISSN: 0151-1238.
NAL Call Number: S5.A46
Descriptors: temperature, relative humidity, cereal grains, insect pest of stored products, environmental factors, Maize, commodities, cassava, wheat, triticale, yams, stored products, rearing techniques, Coleoptera, *Prostephanus truncates*, *Triticum*, *Zea mays*, *Manihot esculenta*, *Dioscorea*, Africa, *Cyperales*, *Liliales*, biodeterioration, techniques and methodology.

1988

Ahmed, Z.I.; Ahmed, R.F. (1988) **[The effect of prey (strawberry mite) densities *Tetranychus turkestani ugarov* and *nikolski* (Acariformes: Tetranychidae) on the functional and numerical efficiency of *Stethorus gilvifrons mulsant* (Coleoptera: Coccinellidae) in the laboratory.]** *Journal of Agriculture and Water Resources Research.* 7(1): 111-122. ISSN: 1012-3474. Notes: In Arabic.
Descriptors: pest mite control, predators, laboratory experiments, temperature, relative humidity, adults, predation, biological control, developmental stages, *Gossypium*, soybeans, orchards, fruit crops, efficiency, reproductivity, *Acarina*, age, Arachnida, biological competition, cultivated land, developmental stages, economic plants, environmental conditions, fibre, foods, grain crops, legumes, green manures, humidity, hydrometeorology, industrial crops, injurious factors, *Malvaceae*, middle east, natural resources, physiological functions, *Prostigmata*, reproduction, *Trombidiformes*.

Leonhardt, B.A.; Dickerson, W.A.; Ridgway, R.L.; Devilbiss, E.D. (1988) **Laboratory and field**

evaluation of controlled release dispensers containing grandlure, the pheromone of the boll weevil (Coleoptera: Curculionidae). *Journal of economic entomology.* 81(3): 937-943. ISSN: 0022-0493.
NAL Call Number: 421 J822
Descriptors: trap, mating disruption, temperature, fiber crop, aggregation pheromone, release, diffuser, efficiency, comparative study, chemical composition, plant insect pest population survey, field study, laboratory study, environmental factor, *Anthonomus grandis*, *Gossypium hirsutum*, Georgia.

Malagon, J.; Garrido, A.; Busto, T. (1988) **Oviposition de los *tenebrionis l.* (coleóptero de *Capnodis*: Bupréstidae) bajo condiciones controladas del laboratorio. [Oviposition of *Capnodis tenebrionis l.* (Coleoptera: Buprestidae) under controlled laboratory conditions.]** *Boletin de Sanidad Vegetal.* 14(1): 99-105. ISSN: 0213-6910. Notes: Ills., graphs, numerical tables, 16 ref., In Spanish.
NAL Call Number: SB950 A1S7
Descriptors: fruit trees, *Capnodis*, oviposition, environmental conditions, environmental control, Coleoptera, physiological functions, trees.

Collembola

1994

Lartey, R.T.; E.A. Curl; C.M. Peterson (1994) **Interactions of mycophagous collembola and biological control fungi in the suppression of *Rhizoctonia solani*.** *Soil biology and biochemistry.* 26(1): 81-88. ISSN: 0038-0717.
NAL Call Number: S592.7.A1S6
Abstract: A rhizosphere-inhabiting collembolan, *Proisotoma minuta* (Insecta:Isotomidae), and three known biocontrol fungi were studied in sterilized and non-sterilized soil for suppression of *Rhizoctonia solani* on cotton in a greenhouse environment. *R. solani* in dried oat culture was incorporated into soil at four inoculum densities ranging from 10 to 150 mg kg-1. *Trichoderma harzianum* on wheat bran and *Gliocladium virens* as dried oatmeal culture were incorporated at 200 and 50 mg kg-1 soil, respectively, and *Laetisaria arvalis* dried, micromilled mycelium was applied as a seed dressing. Each fungus was applied either alone or with a population of *P. minuta* at 1000 kg-1 soil. Most effective biological control occurred in sterilized soil when the fungal biocontrol agents were integrated with the insect population; all combinations provided more effective disease suppression than the fungal agents used alone. In non-sterilized soil, having a natural competitive microflora, only *P. minuta* used alone and the *L. arvalis* + *P. minuta* treatment provided consistently significant disease reduction compared to *R. solani*-infested soil without added agents. Moderate disease control in non-sterilized soil was obtained with *T. harzianum* or *G. virens* when combined with the insect population. Plant-growth dry weight measurements did not consistently reflect the disease control benefit. The specific mechanisms promoting increased biocontrol capacity of insect + fungus combinations, though not clearly defined here, must lie within a complex of factors including preference of *R. solani* as a food source for *P. minuta*, aversion of the insect to the two sporulating *Hyphomycetes* used for

biocontrol, and direct parasitism of *R. solani* by the fungal agents.
Descriptors: *Gossypium hirsutum*, *Rhizoctonia solani*, fungal diseases, plant disease control, *Proisotoma minuta*, *Gliocladium virens*, *Trichoderma harzianum*, *Aphyllophorales*, fungal antagonists, biological control agents, efficacy, interactions, suppressive soils, disease resistance, soil insects, feeding behavior, fecundity, community ecology, rhizosphere.

Lepidoptera

2004

Asano, S. (2004) **[Bioassay methods with the silkworm, *Bombyx mori* for quality control of Bacillus thuringiensis formulations-current method and its modification.]** *Japanese Journal of Applied Entomology and Zoology.* 48(1): 13-21. ISSN: 0021-4914. Note: In Japanese.
NAL Call Number: 475 J27
Descriptors: methods, pest assessment control and management, pesticides, Lepidoptera, Orthoptera, *Bombyx mori,* silkworm, Bacillus thuringiensis, bioassay, laboratory techniques, Japan, assay improvements, biopesticide, environmentally benign, entomology, formulation, method problems, protocol of procedure, quality control, reference sample.

Elmes, G.W.; Wardlaw, J.C.; Schonrogge, K.; Thomas, J.A.; Clarke, R.T. (2004) **Food stress causes differential survival of socially parasitic caterpillars of *Maculinea rebeli* integrated in colonies of host and non-host Myrmica ant species.** *Entomologia Experimentalis et Applicata.* 110(1): 53-63, ISSN: 0013-8703.
NAL Call Number: 421 En895
Descriptors: behavior, terrestrial ecology, Hymenoptera, Lepidoptera, *Myrmica rebeli*, *Myrmica schencki*, ant, *Maculinea rebeli*, caterpillar, experimental regimes, food stress, laboratory cultures, social parasitism, starvation, survival, comparative behavior, environmental biology.

2002

Felke, M.; Lorenz, N.; Langenbruch, G.A. (2002) **Laboratory studies on the effects of pollen from Bt-maize on larvae of some butterfly species.** *Journal of Applied Entomology.* 126(6): 320-325. ISSN: 0931-2048.
NAL Call Number: 421 Z36
Descriptors: insect pest assessment control and management, Lepidoptera, *Bacillus thuringiensis*, biological control agent, pathogens.

Friedrich, L.; A. Schmidt-Tiedemann, K.J. Schirra (2002) **Control of *Sparganothis pilleriana schiff.* and *Lobesia botrana den.* and *schiff.* in German vineyards using sex pheromone-mediated mating disruption.** *IOBC/WPRS Bulletin.* 25: 1-9.
URL: http://phero.net/iobc/samos/bulletin/louis.pdf
Descriptors: viticulture, *Sparganothis pilleriana*, Lepidoptera, *Lobesia botrana*,

pheromones, mating disruption, third generation.

2001

Andow, D.A. (2001) **Patterns of feeding and mortality of adult European corn borer (Lepidoptera: Crambidae) in the laboratory.** *Annals of the Entomological Society of America.* 94(4): 563-565, ISSN: 0013-8746.
NAL Call Number: 420 EN82
Descriptors: terrestrial ecology, environmental biology, Lepidoptera, *Ostrinia nubilalis*, European corn borer, feeding patterns, life expectancy, mortality, sucrose diet, comparative study.

2000

Chocorosqui, V.R.; Pasini, A. (2000) **Predation do *argillacea* de *Alabama* (*hubner*) (Lepidoptera: Crisálidas de Noctuidae) por larvas e por adultos do *perty* do *granulatum* de *Calosoma* (coleópteros: Carabidae) no laboratório. [Predation of *Alabama argillacea* (*hubner*) (Lepidoptera: Noctuidae) pupae by larvae and adults of *Calosoma granulatum perty* (Coleoptera: Carabidae) in the laboratory.]** *Anais da Sociedade Entomologica do Brasil.* 29(1): 65-70. ISSN: 0301-8059. Note: In Portuguese.
NAL Call Number: QL461.S64
Descriptors: economic entomology, terrestrial ecology, pest assessment control and management, Coleoptera, Lepidoptera, *Alabama argillacea*, agricultural pest, prey, pupa, *Calosoma granulatum*, adult, biological control agent, female, larva, male, predator, biological control, predation capacity, predation rate, environmental biology, comparative and experimental morphology, physiology and pathology.

Farrar, R.R.; Ridgway, R.L. (2000) **Laboratory evaluation of selected spray adjuvants as ultraviolet light protectants for the nuclear polyhedrosis virus of the celery looper (Lepidoptera : Noctuidae).** *Journal of Entomological Science.* 35: 239-250. ISSN: 0749-8004.
NAL Call Number: QL461 G4
Descriptors: nuclear polyhedrosis virus, *Spodoptera exigua*, ultraviolet light protectants, sodium lignin sulfonate, fluorescent brightener, feeding stimulant, gypsy-moth Lepidoptera, *Bacillus thuringiensis*, nutrient-based phagostimulants, optical brighteners, *Lymantriidae baculovirus*, radiation protection, activity enhancement, feeding behavior, tobacco budworm, pests.

1999

Li, S.Y.; Otvos, I.S. (1999) **Comparison of the activity enhancement of a baculovirus by optical brighteners against laboratory and field strains of *Choristoneura occidentalis* (Lepidoptera: Tortricidae).** *Journal of Economic Entomology.* 92(3): 534-538. ISSN: 0022-0493.
NAL Call Number: 421 J822

Descriptors: pest assessment control and management, viruses, Lepidoptera, *Choristoneura fumiferana* multicapsid nuclear polyhedrosis virus, Baculoviridae, biological control agent, western spruce budworm, optical brighteners, virus enchancement, virology, comparison study.

1998

Baode, W.; Ferro, D.N. (1998) **Functional responses of *Trichogramma ostriniae* (Hymenoptera: Trichogrammatidae) to *Ostrinia nubilalis* (Lepidoptera : Pyralidae) under laboratory and field conditions.** *Environmental entomology.* 27(3): 752-758. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: parasitoid, entomophagous, functional response, parasitism rate, host, insect pests, population density, temperature, linear regression, biological control, laboratory study, field experiment, *Trichogramma ostriniae*, *Ostrinia nubilalis*, host-parasite relation.

1996

Abot, A.R.; Moscardi, F.; Fuxa, J.R.; Sosa-Gomez, D.R.; Richter, A.R. (1996) **Development of resistance by *Anticarsia gemmatalis* from Brazil and the United States to a nuclear polyhedrosis virus under laboratory selection pressure.** *Biological Control.* 7(1): 126-130. ISSN: 1049-9644.
NAL Call Number: SB925.B5
Descriptors: economic entomology, microbiology, pathology, Baculoviridae, Lepidoptera, Umbelliferae, celery looper, *Anticarsia gemmatalis*, biological control, nuclear polyhedrosis virus, selection study, USA, Brazil.

1995

Dillard, H.R.; A. C. Cobb (1995) **Relationship between leaf injury and colonization of cabbage by *Sclerotinia sclerotiorum.*** *Crop protection.* 14(8): 677-682. ISSN: 0261-2194.
NAL Call Number: SB599.C8
Abstract: Mechanical and insect feeding injuries of cabbage provided sites for ingress by *Sclerotinia sclerotiorum*. In field studies, injuries sustained by hitting cabbage heads with a blunt object penetrated several leaf layers and were readily infected by *S. sclerotiorum*. Incidence of *Sclerotinia* rot ranged from 15 to 36% infected plants in the hitting treatment. Disease incidence was low (0-5%) when wounds were created by allowing lepidopterous larvae (the imported cabbageworm, *Pieris rapae l.*, the diamondback moth, *Plutella xylostella l.*, and the cabbage looper. *Trichoplusia ni hubner*) to feed on cabbage leaves. The incidence of colonization of lepidopterous larvae feeding sites by *S. sclerotiorum* was greater in greenhouse studies (5-60% infected feeding sites) than in field studies. In greenhouse studies, disease incidence was significantly greater in plants receiving hitting injuries than tearing injuries. There was little evidence of inoculation day or injury day effects. Colonization frequency of tissue injured mechanically was

similar whether wounds were inoculated immediately or 4 days later. Plants that were incubated in a dry environment developed fewer infections than plants held in a moist environment. Inoculated plants that were not injured did not develop disease.
Descriptors: *Brassica oleracea var*, *Capitata*, *Sclerotinia sclerotiorum*, plant pathogenic fungi, infectivity, leaves, injuries, *Pieris rapae*, *Plutella xylostella*, *Trichoplusia ni*, fungal diseases, incidence, greenhouse culture, plant disease control, fungus control, New York, Lepidoptera.

Greenstone, M.H. (1995) **Bollworm or budworm? Squashblot immunoassay distinguishes eggs of *Helicoverpa zea* and *Heliothis virescens* (Lepidoptera: Noctuidae).** *Journal of economic entomology.* 88(2): 213-218. ISSN: 0022-0493.
NAL Call Number: 421 J822
Abstract: Management of pyrethroid resistance in the tobacco budworm, *Heliothis virescens* (*f.*), requires some means to distinguish it from the cotton bollworm, *Helicoverpa zea boddie*, preferably at the egg stage. The subtle morphological differences that have been described are not useful for field identification. Eggs squashed on nitrocellulose membranes can be unambiguously distinguished by a rapid assay that uses a monoclonal antibody to *H. zea* egg homogenate. Use of the assay to identify eggs in the field would provide the data needed to make a decision on whether or not to spray pyrethroids. Adoption of a resistance management strategy employing the assay in this fashion would delay the development of pyrethroid resistance in *H. virescens*, reduce wasteful spraying of pyrethroids and concomitant environmental pollution, save money otherwise lost by spraying the wrong insecticide, and enhance biological control by conserving natural enemies.
Descriptors: *Helicoverpa zea*, *Heliothis virescens*, ova, identification, immunoassay, monoclonal antibodies, pests.

Hajek, A.E.; Butler, L.; Wheeler, M.M. (1995) **Laboratory bioassays testing the host range of the gypsy moth fungal pathogen *Entomophaga maimaiga*.** *Biological Control.* 5(4): 530-544. ISSN: 1049-9644.
NAL Call Number: SB925.B5
Descriptors: forest ecology, infection, Lepidoptera, *Entomophaga maimaiga*, *Lymantria dispar*, biological control, epizootic, seasonality, environmental bioclimatology and biometeorology, phytopathology, host range.

1992

Igbinosa, I.B. (1992) **Field and laboratory techniques for assessing infestations of the nettle caterpillar, *Latoia viridissima holland* (Lepidoptera: Limacodidae).** *Insect Science and its Application.* 13(3): 389-398. ISSN: 0191-9040.
NAL Call Number: QL461.I57
Descriptors: ecology, necrosis, parasitology, pathology, physiology, reproductive system, Diptera, Hymenoptera, Lepidoptera, fungi, *Brachymeria* sp., *Chrysis spina*, *Coccygodes coccyx*, *Latoia viridissima*, *Palexorista* sp., *Systropus pelopoeus*, fecundity, larvae, natural enemies, outbreak forecasting, palm insect pest, parasite populations, predators, developmental biology, mycology, comparative study, mathematical and statistical methods.

Mulrooney, J.E.; Parrott, W.L.; Wilcox, P.A. (1992) **Performance of laboratory strains of *Heliothis virescens* (*f.*) (Lepidoptera: Noctuidae) in feeding tests as affected by outcrossing to the wild.** *Southwestern Entomologist.* 17(4): 319-326. ISSN: 0147-1724.
NAL Call Number: QL461 S65
Descriptors: insect strains, diets, genetics, morphology, nutrition, pest assessment control and management, physiology, Lepidoptera, *Heliothis virescens*, gossypol acetic acid, body size, potential biological control, pupation, survival.

Slovak, M. (1992) **Suitability of *Exetastes cinctipes* and *Microplitis mediator* for mass rearing against cabbage moth.** *Ochrana Rostlin.* 28(2): 91-94. ISSN: 0036-5394.
NAL Call Number: SB950.3 C95O23
Descriptors: *Mamestra brassicae*, Ichneumonidae, biological control methods, air temperature, mass rearing techniques, environmental factors, temperature, Hymenoptera, Lepidoptera, Mamestra.

1989

Buckingham, G.R.; Bennett, C.A. (1989) **Laboratory host range of *Parapoynx diminutalis* (Lepidoptera: Pyralidae), an Asian aquatic moth adventive in Florida and Panama on *Hydrilla verticillata* (Hydrocharitaceae).** *Environmental entomology.* 18(3): 526-530. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: host preferences, host plants, host ranges, weed, phytophagous, freshwater environment, biological control, laboratory study.

Hemiptera

1997

Sant'Ana, J.; R. Bruni; A.A. Abdul Baki; J.R. Aldrich (1997) **Pheromone-induced movement of nymphs of the predator, *Podisus maculiventris* (Heteroptera: Pentatomidae).** *Biological control: theory and applications in pest management.* 10(2): 123-128. ISSN: 1049-9644.
NAL Call Number: SB925.B5
Abstract: Males of the generalist predator, *Podisus maculiventris* (*say*) (Heteroptera: Pentatomidae) (known as the spined soldier bug), attract mates with a pheromone, but the immature stages of the predator also appeared to be attracted. Therefore, attraction of nymphs of *P. maculiventris* to pheromone was studied in a wind tunnel and in field plots. The behavior of individual nymphs toward pheromone with and without Colorado potato beetles, *Leptinotarsa decemilineata* (*say*) (Chrysomelidae), and/or potato plants in the airstream was studied in a wind tunnel. Field experiments were performed in plots planted with green beans, *Phaseolus vulgaris l.* that were allowed to become naturally infested with Mexican bean beetles, *Epilachna varivestis* (*moulsant*) (Coccinellidae). Spined soldier bug nymphs were released in the middle row of plots planted for 3 weeks, and three commercial pheromone dispensers were placed outside the thirteenth row of a plot. *Podisus maculiventris* nymphs were significantly attracted to synthetic pheromone

both in the laboratory and in the field. Results of wind tunnel experiments indicated that combining the pheromone with the phytophage significantly increased the positive responses of nymphs compared to the pheromone alone; however, inclusion of damaged or undamaged potato plants with pheromone did not enhance the positive responses to the odor source. Spined soldier bugs released in field plots remained relatively sedentary for the first day after release, but by the end of the 1-week sampling period nymphs had significantly moved into rows nearer the pheromone dispensers. The ability to manipulate immature spined soldier bugs significantly expands the potential for using this generalist predator in integrated pest management programs.
Descriptors: *Podisus maculiventris*, nymphs, movement, behavior, aggregation pheromones, *Leptinotarsa decemlineata*, *Solanum tuberosum*, wind tunnels, *Epilachna varivestis*, *Phaseolus vulgaris*, predators of insect pests, predator augmentation.

Stack, P.A.; F.A. Drummond (1997) **Reproduction and development of *Orius insidiosus* in a blue light-supplemented short photoperiod.** *Biological control: theory and applications in pest management.* 9(1): 59-65. ISSN: 1049-9644.
NAL Call Number: SB925.B5
Abstract: An important limitation in using the insidious flower bug, *Orius insidiosus* (*say*) (Hemiptera:Anthocoridae), as a biological control agent in north temperate winter greenhouse crop production is its tendency to enter reproductive diapause during short photoperiods. Laboratory experiments assessed the effect of a blue light-supplemented short photoperiod over a range of temperature regimes on female reproductive diapause induction, nymph development and survival, ovarian maturation period, and oviposition of *O. insidiosus*. In experiment one, all *O. insidiosus* life stages were exposed to a broad-spectrum photoperiod of 15:9 (L:D) h, a blue light-supplemented photoperiod of 9:15 (L:D) h, consisting of 9 h broad-spectrum light followed by 6 h blue light, or a broad-spectrum photoperiod of 9:15 (L:D) h, all at 24 +/- 1 degrees C. Approximately 75% of mated females reproduced in the broad-spectrum long photoperiod and the blue light-supplemented short photoperiod regimes, whereas over 50% of the bugs diapaused in the broad-spectrum short photoperiod regime. There was no difference among the light treatments for all other measured responses. In experiment two, all *O. insidiosus* life stages were exposed to the blue light-supplemented short photoperiod over a range of temperature regimes (19-28 degrees C). At least 90% of mated females reproduced at each temperature. A linear relationship occurred for temperature and nymph development and for temperature and ovarian maturation period. The oviposition rate was similar at 22 degrees, 25 degrees, and 28 degrees C. This study indicates the potential for using supplemental blue light to enhance *O. insidiosus* reproduction in a short photoperiod and may be important as a biological control strategy in winter greenhouse production systems.
Descriptors: *Orius insidiosus*, reproduction, diapause, photoperiod, blue light, biological development, survival, ovarian development, oviposition, environmental temperature, biological control agents, predators of insect pests, *Frankliniella occidentalis*, *Dendranthema*.

1996

Painter, M.K.; K.J. Tennessen; T.D. Richardson (1996) **Effects of repeated applications of**

Bacillus thuringiensis israelensis on the mosquito predator Erythemis simplicicollis (Odonata: Libellulidae) from hatching to final instar. *Environmental entomology.* 25(1): 184-191. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Abstract: Nymphs of a common dragonfly, *Erythemis simplicicollis* (*say*), were exposed to *Bacillus thuringiensis israelensis* de Barjac at 1.2 ppm once a week for an entire life cycle in a controlled laboratory environment. Eight weekly applications were administered to 2 treatment groups: external contact only, and external + internal contact using prey (mostly anopheline larvae) that had fed on *B. thuringiensis*. Each *B. thuringiensis*-treated group and a control group consisted of 15 nymphs. Mortality was not affected by *B. thuringiensis* applications. Repeated *B. thuringiensis* applications did not affect development to the adult stage, morphology, or maiden flight capability. Nymph size of the external contact group, measured by hind femur length and head width, was substantially smaller compared with the control group in most instars from 4-12. However, adult size, based on head width and hind wing length comparisons, did not differ among the 3 groups. Prey consumption and instar duration, which were highly correlated, did not account for the differences in size. Sex ratio (lower proportion of large females in the external group) and initial size (slightly smaller in instar 2 in the external group) appeared to be the major factors contributing to the size differences in the external group. However, these variables were not responsible for the external + internal contact group being smaller in instar 10 compared with the controls, as sex ratios and initial size were equal. If repeated *B. thuringiensis* applications affect size in *E. simplicicollis*, the effect may be insignificant in terms of reproductive success, as published studies do not show a positive relationship between size and reproductive success in dragonflies.
Descriptors: Libellulidae, *Bacillus thuringiensis* subsp *israelensis*, exposure, nontarget effects and organisms, predators of insect pests, nymphs, mortality, prey, consumption, growth rate, biological development, biological control agents, Culicidae.

1993

Darriet, F.; Hougard, J.M. (1993) **Étude de laboratoire sur la biologie et le potentiel prédateur du *vicina* aquatique de *parvipes* de *Ranatra* de bogue (Signoret, 1880) (Insecta, Heteroptera, Nepidae) pour la commande de la population larvaire de moustique. [Laboratory study on the biology and predatory potential of the aquatic bug *Ranatra parvipes vicina* (Signoret, 1880) (Insecta, Heteroptera, Nepidae) for the control of mosquito larval population.]** *Revue d'hydrobiologie tropicale.* 26(4): 305-311.
ISSN: 0240-8783, Note: In French.
NAL Call Number: QH91 A103
Descriptors: laboratory study, biological control of mosquito larvae, predator prey relation, feeding preference, Cameroon, developmental stages, *Aedes aegypti*, *Anopheles gambiae*, freshwater environments, Africa.

Powell, J.E.; L. Lambert (1993) **Soybean genotype effects on bigeyed bug feeding on corn earworm in the laboratory.** *Crop science.* 33(3): 556-559. ISSN: 0011-183X.
NAL Call Number: 64.8 C883
Abstract: Corn earworm, *Helicoverpa zea* (*boddie*), is a serious pest of many crops,

including soybean, *Glycine max (l.) merr*. This study was conducted to determine whether or not plant pubescence could be used to enhance predator activity. The influence of plant pubescence or insect resistance of soybean on predation of corn earworm eggs by the bigeyed bug, *Geocoris punctipes* (*say*), was investigated in the laboratory. Bigeyed bug adults were allowed to feed on corn earworm eggs that were placed on foliage of soybean genotypes isogenic for dense, normal, or no pubescence, and on genotypes susceptible or resistant to foliar feeding insects. Percent egg puncture by males was similar on all foliage types whether or not choices were offered. Females punctured significantly ($P < 0.05$) more eggs on normal leaflets in a no choice situation. Significant differences ($P > 0.05$) were not detected in percent en puncture on soybean genotypes resistant to foliar feeding insects as compared with susceptible genotypes 'Centennial' and 'Davis'). Development of soybean cultivars with reduced pubescence, which is less preferred by corn earworm for oviposition and/or foliar feeding, will probably not influence this beneficial predator, since egg predation was not adversely affected by plant pubescence or insect resistance under laboratory test conditions.
Descriptors: *Glycine max*, *Helicoverpa zea*, predator prey relationships, *Geocoris punctipes*, leaves, *Trichomes*, pest resistance, feeding behavior, oviposition, predation, genotypes, biological and genetic control, Hemiptera.

1992

Parajulee, M.N.; Phillips, T.W. (1992) **Laboratory rearing and field observations of *Lyctocoris campestris* (Heteroptera: Anthocoridae), a predator of stored-product insects.** *Annals of the Entomological Society of America.* 85(6): 736-743. ISSN: 0013-8746.
NAL Call Number: 420 En82
Descriptors: behavior, ecology, economic entomology, nutrition, physiology, Heteroptera, *Lyctocoris campestris*, biological control, life history, natural enemy, sex ratio, stored grain, behavioral biology, environmental biology, comparative and experimental morphology, pathology.

1976

Evans, H.F. (1976) **The population dynamics of *Anthocoris Confusus* in a laboratory cage ecosystem.** *Journal of animal ecology.* 45(3): 773-789. ISSN: 0021-8790.
NAL Call Number: 410 J826
Descriptors: population density and dynamics, environment, biological control, laboratory population, ecology, Hemiptera.

Homoptera

2000

Ponsonby, D.J.; Copland, M.J. (2000) **Environmental effects on the development and survival of the scale insect *Abgrallaspis cyanophylli* (*signoret*) (Homoptera:**

Diaspididae) with reference to its suitability for use as a host for rearing biological control agents. *Biocontrol Science and Technology.* 10(5): 583-594. ISSN: 0958-3157.
NAL Call Number: SB975.B562
Descriptors: *Abgrallaspis cyanophylli*, Diaspididae, biological control, mass rearing, *Chilocorus nigritus*, temperature, predator.

1999

English-Loeb, G.; Villani, M.; Martinson, T.; Forsline, A.; Consolie, N. (1999) **Use of entomopathogenic nematodes for control of grape phylloxera (Homoptera : Phylloxeridae): A laboratory evaluation.** *Environmental entomology.* 28(5): 890-894. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: parasitic efficiency, entomopathogen, insect pests, fruit crop, dose activity relation, reproduction, humidity, soils, laboratory study, biological control, *Vitis vinifera*, *Daktulosphaira vitifoliae*, *Heterorhabditis bacteriophora*, *Steinernema glaseri*, environmental factor, host parasite relation, Phylloxeridae, Aphidoidea, Homoptera, Nematoda, Nemathelminthia, Helmintha.

1998

Van Dam, N.M.; J.D. Hare (1998) **Differences in distribution and performance of two sap-sucking herbivores on glandular and non-glandular *Datura wrightii*.** *Ecological entomology.* 23(1): 22-32. ISSN: 0307-6946.
NAL Call Number: QL461.E4
Abstract: 1. *Datura wrightii regel* (*solanaceae*) is polymorphic with regard to trichome type. Some plants are densely covered with short, non-glandular trichomes, whereas other plants in the same populations possess glandular trichomes that excrete a sticky exudate. The hypothesis that glandular trichomes enhance resistance to all small insect herbivores is evaluated. 2. Field censuses in four southern Californian *D. wrightii* plant populations revealed that glandular plants are indeed resistant to whitefly spp. (Homoptera: Aleyrodidae). Whiteflies are almost exclusively found on non-glandular plants. In contrast, *Tupiocoris notatus* (*distant*) (Heteroptera: Miridae), another sap-sucking herbivore of similar body size, is found predominantly on plants with glandular trichomes. 3. Laboratory experiments showed that whiteflies are unable to colonize glandular *D. wrightii* phenotypes. After the whitefly adults had landed on the leaves of these plants, they were trapped in the exudate and died. 4. *Tupiocoris notatus* adults, on the other hand, laid significantly more eggs on glandular plants. The presence of the exudate was shown to be the cue that determined their choice of glandular plants. 5. In no-choice experiments, *T. notatus* nymphs reared on glandular plants had significantly higher survival rates and had shorter developmental periods than those raised on non-glandular plants. This, combined with the higher oviposition rates, resulted in higher *T. notatus* population growth rates on glandular plants than on non-glandular plants. 6. Glandular trichomes are not therefore a universal protection against small herbivores. Differences in distribution over the two plant types within the natural herbivore guild on *D. wrightii* may, among other selection pressures, contribute to the

maintenance of the observed trichome polymorphism.
Descriptors: *Datura wrightii*, *Bemisia argentifolii*, *Trialeurodes vaporariorum*, *Trialeurodes abutiloneus*, Miridae, pest resistance, trichomes, polymorphism, exudates, population density, oviposition, species differences, biological development, survival, population growth, California, whiteflies, Homoptera.

1995

McClure, M.S. (1995) ***Diapterobates humeralis*** **(Oribatida: Ceratozetidae): an effective control agent of hemlock woolly adelgid (Homoptera: Adelgidae) in Japan.**
Environmental entomology. 24(5): 1207-1215. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Abstract: The hemlock woolly adelgid, *Adelges tsugae annand*, is maintained at innocuous population levels in Japan on its 2 native hosts, *Tsuga diversifolia masters* and *T. sieboldii carriere*, by host resistance and natural enemies. The most common enemy associated with infestations of *A. tsugae* in Japan was *Diapterobates humeralis* (*hermann*), an arboreal oribatid mite that inhabits coniferous forests throughout the Northern Hemisphere, where it usually feeds on decaying plant tissues, fungi, algae, and lichens. This mite occurred in 12 of 13 prefectures and at 42 of the 76 sites (55%) that were sampled in Honshu, Japan, from 34 to 37 degrees N latitude and between sea level and 2,100 m elevation. This included 17 of 37 forest sites (46%) and 23 of 37 ornamental sites (62%) where adelgids were present, and 2 uninfested ornamental sites. Laboratory cage experiments revealed that *D. humeralis* did not eat adelgid eggs or nymphs, but rather consumed the woolly filaments that enveloped the ovisacs. However, in so doing 20 adult mites dislodged >95% of the eggs contained within 10 ovisacs from hemlock branches in 7 d. This 2:1 ratio of mites to ovisacs is representative of densities in the field. More eggs were dislodged from ovisacs located along the twig (99%) than from those located at the base of terminal buds (95%), the usual oviposition sites when adelgid densities are high and low, respectively. In a field experiment that simulated effects of egg dislodgment by mites, not a single adelgid was found on any of 4 hemlocks beneath which 2,383 eggs had been placed 16 d earlier. Hatching adelgid nymphs were unable to colonize nearby trees and fell victim to desiccation and generalist predators, mainly ants and spiders that inhabited the forest floor. During the same period 96% of 2,262 adelgids placed directly on 4 other hemlocks successfully colonized the trees. *D. humeralis* destroyed 86-94% of adelgid egg masses at all 17 infested forest sites and 99-100% of them at 16 of the 23 infested ornamental sites. Included in this latter group were 2 sites where adelgids had been controlled on *T. canadensis* (*l.*) *carriere*, a highly susceptible North American species. At the other 7 infested ornamental sites where adelgid mortality ranged from 55 to 83%, mites were abundant and were ravaging egg masses of *A. tsugae* when trees were 1st sampled. At 2 of these latter sites that were revisited 3 wk later, only 2-3% of the ovisacs were viable and adelgid densities had been reduced by 90-93%. Although *D. humeralis* was not a predator of *A. tsugae*, it was a highly effective control agent by dislodging adelgids from the trees and killing them as it fed on the woolly filaments surrounding the ovisacs. The wide climatic and environmental tolerance of this mite in Japan, its voracity in consuming the woolly ovisacs of *A. tsugae*, its propensity to dislodge adelgid eggs from trees, its ability to reduce adelgid populations to innocuous levels on *T. canadensis* in Japan, and its harmlessness to other organisms in the

environment make *D. humeralis* an excellent biological control candidate for North America.
Descriptors: *Tsuga*, *Adelges*, *Cryptostigmata*, feeding behavior, ova, mortality, biological control agents, natural enemies, *Honshu*.

1989

Crovetti, A.; Rossi, E. (1989) **Field and laboratory observations on some eco-ethological aspects of the grape phylloxera (*Viteus vitifoliae* (*fitch*)).** *Meeting on influence of environmental factors on the control of grape pests, diseases and weeds. Proceedings (Thessaloniki).* 1987-10-06: 107-114. Note: Institut national de la recherche agronomique (INRA, France)-DOCVE CG1276.
Descriptors: fruit crop, insect plant relation, environmental factors, polymorphism, laboratory study, field study, sensitivity resistance, plant origin, pest, *Daktulosphaira vitifoliae*, *Vitis vinifera*, grapevine root-aphid, Phylloxeridae, Aphidoidea, Homoptera, comparative study.

Hymenoptera

2004

Kuske, S.; Babendreier, D.; Edwards, P.J; Turlings, T.C.; Bigler, F. (2004) **Parasitism of non-target lepidoptera by mass released *Trichogramma brassicae* and its implication for the larval parasitoid *Lydella thompsoni*.** *BioControl.* 49(1): 1-19. ISSN: 1386-6141.
NAL Call Number: SB975 .B5636
Descriptors: economic entomology, pest assessment control and management, terrestrial ecology, Lepidoptera, *Lydella thompsoni,* parasite, larval parasitoid, *Trichogramma brassicae,* Hymenoptera, biological control agent, inundative releases, *Archanara geminipuncta, Chilo phragmitellus, Ostrinia nubilalis,* biological control, laboratory host specificity tests, non-target effects, oviposition period, parasitism rates, potential negative effects, environmental biology.

2002

Guillen, L.; Aluja, M.; Equihua, M.; Sivinski, J. (2002) **Performance of two fruit fly (Diptera : Tephritidae) pupal parasitoids (*Coptera haywardi* [Hymenoptera : Diapriidae] and *Pachycrepoideus vindemiae* [Hymenoptera : Pteromalidae]) under different environmental soil conditions.** *Biological Control.* 23(3): 219-227. ISSN: 1049-9644.
NAL Call Number: SB925.B5
Descriptors: *Coptera haywardi*, *Pachycrepoideus vindemiae* larvae, pupal burial depth, Tephritidae, pupae parasitoids, biological control, soil type, house fly, suppression, population, Muscidae, Mexico.

2000

Greenberg, L.; J.H. Klotz (2000) **Argentine ant (Hymenoptera: Formicidae) trail pheromone enhances consumption of liquid sucrose solution.** *Journal of economic entomology.* 93(1): 119-122. ISSN: 0022-0493.
NAL Call Number: 421 J822
Abstract: We investigated whether the Argentine ant, *Linepithema humile* (*mayr*), trail pheromone, Z9-16:Ald, could enhance recruitment to and consumption of liquid sucrose solutions. All tests were done as paired comparisons with a 10% sucrose solution as food. In the laboratory, mixing 20 microliters of a 10-microgram/ml solution of the pheromone with 50 microliters of the 10% sucrose solution increased the number of ants feeding by >150%. In a field test, we combined the trail pheromone with a 10% sucrose solution in 50-ml vials. These vials were covered with a plastic membrane that has 1.5-mm-diameter holes punched uniformly across its surface. Ants could drink from the holes after the vials were inverted. For half of the vials, 1 microgram of the pheromone was put onto the plastic membrane before the vials were filled with a 10% sucrose solution. The remaining vials had no pheromone on the plastic membrane. After 4 h we measured the consumption in each vial. Bait consumption with the pheromone was enhanced by 29%. In a 2nd series of tests, vials were left outside for 24 h. The consumption rate was 33% higher with the pheromone compared with the controls that didn't have pheromone.
Descriptors: *Linepithema humile*, trail pheromones, baits, sucrose, solutions, recruitment, food intake, baiting, efficacy, biocontrol.

1999

Bernal J.S.; R.F. Luck; J.G. Morse (1999) **Host influences on sex ratio, longevity, and egg load of two *Metaphycus* species parasitic on soft scales: implications for insectary rearing.** *Entomologia experimentalis et applicata.* 92(2): 191-204. ISSN: 0013-8703.
NAL Call Number: 421 En895
Abstract: *Metaphycus flavus* (*howard*) and *M. stanleyi compere* (Hymenoptera: Encyrtidae) are currently being screened for use as augmentative biological control agents of citrus-infesting soft scales (Homoptera: Coccidae). Two factors were investigated, host quality-dependent sex allocation and local mate competition, which likely influence these parasitoid's sex allocation strategies and are therefore of interest for their mass-rearing. The results of these studies suggested that, under the mass-rearing protocol that is envisioned for these parasitoids, offspring sex ratios in both *M. flavus* and *M. stanleyi* are dominated by host quality (= size) influences, but not by interactions with other females. These results indicated that host size strongly influences offspring sex ratios and brood sizes; larger hosts led to more female offspring and larger broods. In contrast, increasing the number of parental females did not lead to fewer female offspring as expected under local mate competition. Additionally, within-brood sex ratios did not vary with brood size; this result is inconsistent with expected sex ratios due to local mate competition. Other results also indicated that host quality was a dominant influence on *M. flavus*' and *M. stanleyi*'s sex ratios. Larger hosts led to a larger size in the emerging wasps, and larger wasps had greater egg loads and lived longer than smaller wasps. However, wasp longevity, and the influence of wasp size on longevity were mediated by

a wasp's diet. *Metaphycus flavus* females lived the longest when they had access to hosts, honey, and water, followed by honey and water, and shortest when they had access to water alone; *M. stanleyi* females lived longest with honey and water, followed by hosts, honey, and water, and shortest with water alone. Greater wasp size led to greater longevity in females only when they had access to food (honey, or hosts and honey). Finally, other results suggested that both *M. flavus* and *M. stanleyi* are facultatively gregarious. Wasp size did not decrease with brood size as expected under superparasitism. Overall, the results of these studies suggested that holding newly emerged females of both *M. flavus* and *M. stanleyi* for several days in the presence of an appropriate food source before field release could enhance a female's performance as an augmentative biological control agent. It increases their initial life expectancy following release, and maximizes the females' egg load (both *Metaphycus* species) and resources for replacing oviposited eggs (*M. flavus* only).
Descriptors: *Metaphycus flavus*, *M. stanleyi*, *Coccus hesperidum*, parasitoids, parasites of insect pests, host parasite relationships, quality, size, sex ratio, longevity, diet, fecundity, intraspecific competition, mass rearing, biological control agents.

1998

Reed, D.A.; J.J. Brown (1998) **Host/parasitoid interactions: critical timing of parasitoid-derived products.** *Journal of insect physiology*. 44(9): 721-732. ISSN: 0022-1910.
NAL Call Number: 421 J825
Abstract: Short-term in vitro incubations were used to examine the ability of endoparasitoid larvae to produce and release both ecdysteroids and proteins into their environment. Second instar larvae of both *Chelonus near curvimaculatus* and *Ascogaster quadridentata* were observed by SDS-PAGE to release temporally-similar polypeptides in the 20-30 kD Mr range. Peak occurrence of these polypeptides coincided with shedding of the anal vesicle, immediately prior to ecdysis to the third instar. Ecdysis also coincided with the switch from endoparasitic to ectoparasitic development in vivo. Polyclonal antibodies were generated against a particular 27 kD polypeptide of *Chelonus*, which was found to be species-specific and localized primarily within the anal vesicle during the latter part of the second stadium and whole body homogenates of third instars. In vitro incorporation studies using 35S-methionine indicated rapid changes in the synthetic abilities of second instar larvae shortly before ecdysis. The production and release of ecdysteroids, as measured by RIA, was found to precede the peak occurrence of the 27 kD polypeptide and ecdysteroid presence was undetectable following the molt. In contrast, the polypeptides were observed to gradually increase prior to the molt and slowly decrease after the molt. The *Chelonus* polypeptide was not detected in host tissues until after parasitoid egression.
Descriptors: *Chelonus*, *Ascogaster quadridentatus*, *Trichoplusia ni*, *Cydia pomonella*, parasitoids, parasites of insect pests, parasitism, molting hormones, polypeptides, hormone secretion, protein secretion, in vitro, timing, ecdysis, localization, host parasite relationships, biological development.

Wang, B.; Ferro, D.N. (1998) **Functional responses of *Trichogramma ostriniae* (Hymenoptera: Trichogrammatidae) to *Ostrinia nubilalis* (Lepidoptera: Pyralidae)**

under laboratory and field conditions. *Environmental Entomology.* 27(3): 752-758. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: pests, maize, temperature, environmental factors, hosts, parasitoids, beneficial insects, biological control, agents, natural enemies, cereals, *Trichogramma ostriniae*, *Ostrinia nubilalis*, *Zea mays*, Hymenoptera, Pyralidae, Lepidoptera, Poaceae, *Cyperales*, OECD countries, insect behavior, New England.

1997

England, S.; E.W. Evans (1997) **Effects of pea aphid (Homoptera: Aphididae) honeydew on longevity and fecundity of the alfalfa weevil (Coleoptera: Curculionidae) parasitoid *Bathyplectes curculionis* (Hymenoptera: Ichneumonidae).** *Environmental Entomology.* 26(6): 1437-1441. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Abstract: The ability of parasitoids to attack their hosts may be influenced by the availability of adult food sources such as homopteran honeydew. To test this hypothesis for the wasp *Bathyplectes curculionis* (*thomson*), a parasitoid of the alfalfa weevil, *Hypera postica* (*gyllenhal*), we performed laboratory experiments to determine whether availability of pea aphid, *Acyrthosiphon pisum* (*harris*), honeydew influenced adult longevity and fecundity of the wasp. Adult wasps caged with alfalfa, *Medicago sativa l.*, and pea aphids fed on the aphid honeydew and lived approximately 50% longer than wasps caged with alfalfa alone. In a related experiment, newly emerged, unmated *B. curculionis* females were allowed to feed for 2 d on pea aphid honeydew, sucrose dissolved in water, or water alone, and were then dissected to determine the number of eggs in a lateral oviduct. Egg production was slightly (11-15%) but significantly greater in females with access to pea aphid honeydew or sugar water than in females with access to water only. These results suggest that availability of pea aphid honeydew in alfalfa fields may enhance the realized fecundity of *B. curculionis*. Hence, the presence of pea aphids in moderate numbers may be beneficial for biological control of the alfalfa weevil.
Descriptors: *Bathyplectes curculionis*, *Acyrthosiphon pisum*, sucrose, nutrient sources, longevity, parasitoids, fecundity, parasites of insect pests, *Hypera postica*, honeydew, alfalfa fields.

1996

Henter, H.J.; Van Lenteren, J.C. (1996) **Variation between laboratory populations in the performance of the parasitoid *Encarsia formosa* on two host species, *Bemisia tabaci* and *Trialeurodes vaporariorum*.** *Entomologia Experimentalis et Applicata.* 80(2): 427-434. ISSN: 0013-8703.
NAL Call Number: 421 EN895
Descriptors: environmental biology, parasitology, pathology, physiology, reproductive system, Homoptera, Hymenoptera, Aphelinidae, *Bemisia tabaci*, *Encarsia formosa*, *Trialeurodes vaporariorum*, host-parasitoid interactions, intraspecific variation,

parthenogenetic reproduction, population studies, potential biocontrol species, comparative biology.

1995

Grille, G.; Basso, C. (1995) **Biology, thermal requirements and performance of *Trichogramma pretiosum riley* and *T. galloi zucchi* under laboratory conditions *Trichogramma* and other egg parasitoids.** *Les colloques de l'INRA.* (73): 79-82. ISSN: 0293-1915. Note: International Symposium on Trichogramma and Other Egg Parasitoids, 4 (Cairo EGY) 1994-10-04.
NAL Call Number: S539.7 C6
Descriptors: egg parasitoids, entomophagous, population density, ecological abundance, interspecific comparison, fecundity, longevity, temperature, biological control, pest, *Trichogramma pretiosum*, *Diatraea saccharalis*, *Suedamerika*, environmental factor, Uruguay.

1994

Burnham, K.D.; Baldridge, R.S.; Duhrkopf, R.E.; Vodopich, D.S. (1994) **Laboratory study of predation by *Solenopsis invicta* (Hymenoptera: Formicidae) on eggs of *Aedes albopictus* (Diptera: Culicidae).** *Journal of Medical Entomology.* 31(5): 770-771. ISSN: 0022-2585.
NAL Call Number: 421 J828
Descriptors: ecology, pathology, physiology, reproduction, Diptera, Hymenoptera, *Aedes albopictus*, *Solenopsis invicta*, mortality, population dynamics, behavioral biology, environmental biology, pathology, necrosis.

Mwangi, E.N.; Kaaya, G.P.; Essuman, S.; Kimondo, M.G. (1994) **Parasitism of *Amblyomma variegatum* by a hymenopteran parasitoid in the laboratory, and some aspects of its basic biology.** *Biological Control.* 4(2): 101-104. ISSN: 1049-9644.
NAL Call Number: SB925.B5
Descriptors: ectoparasites, parasitism, laboratory study, development, temperature, parasitoids, hosts, environmental factors, cattle, rabbits, *Amblyomma variegatum*, *Ixodiphagus hookeri*, Bovidae, ruminants, Artiodactyla, ungulates, Leporidae, *Amblyomma*, Ixodidae, Metastigmata, Acari, Arachnida, Hymenoptera, developing countries, parasites, vectors, pathogens of animals, biological control, behavior, Kenya.

Sengonca, C.; Uygun, N.; Ulusoy, M.R.; Kersting, U. (1994) **Laboratory studies on biology and ecology of *Eretmocerus debachi rose* and *rosen* (Hym., Aphelinidae) the parasitoid of *Parabemisia myricae* (Kuwana) (Hom., Aleyrodidae).** *Journal of Applied Entomology.* 118(4-5): 407-412. ISSN: 0931-2048.
NAL Call Number: 421 Z36
Descriptors: life cycle, methods and techniques, parasitology, pathology, physiology, Homoptera, Hymenoptera, *Eretmocerus debachi*, *Parabemisia myricae*, biological control, population dynamics, seasonality, environmental biology, temperature as a

primary variable, embryology, morphogenesis, comparative and experimental morphology.

1993

Schmidt, G.H.; Kitt, J. (1993) **Laboratory rearing of *Ooencyrtus pityocampae* in unfertilized and unlaid eggs of *Thaumetopoea* species.** *Naturwissenschaften.* 80(8): 379-380. ISSN: 0028-1042.
NAL Call Number: 474 N213
Descriptors: ecology, economic entomology, parasitology, pathology, physiology, Hymenoptera, Lepidoptera, *Ooencyrtus pityocampae*, *Thaumetopoea pityocampa*, *Thaumetopoea wilkinsoni*, insect pest, biological control, egg parasitoid, environmental biology.

1992

Calderone, N.W. (1992) **An integrated response to pollination related problems resulting from parasitic honey-bee mites and the Africanized honey bee.** *Sustainable Agriculture Research and Education SARE or Agriculture in Concert with the Environment ACE research projects.* (33) 1988. 17 pgs.
NAL Call Number: S441.S855
Descriptors: *Apis mellifera*, pest resistance, *Acarapis woodi*, *Varroa jacobsoni*, breeding programs, mite control, acaricidal plants, screening, efficacy, beekeeping, biological control, Maryland, Pennsylvania, Delaware, New York.

Morales-Ramos, J.A.; Cate, J.R. (1992) **Rate of increase and adult longevity of *Catolaccus grandis* (*burks*) (Hymenoptera: Pteromalidae) in the laboratory at four temperatures.** *Environmental Entomology.* 21(3): 620-627. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: temperature effects, natural enemies, insect pests, parasitoids, hosts, environmental factors, *Catolaccus grandis*, Hymenoptera, Coleoptera, *Anthonomus grandis*, biological control.

Pereira, R.M.; Stimac, J.L. (1992) **Transmission of *Beauveria bassiana* within nests of *Solenopsis invicta* (Hymenoptera: Formicidae) in the laboratory.** *Environmental Entomology.* 21(6): 1427-1432. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: ecology, infection, pathology, *Fungi imperfecti*, Deuteromycetes, Hymenoptera, *Beauveria bassiana*, *Solenopsis invicta*, biological control agent, infection rates and transmission, pest control, mycology of ant nest.

Stouthamer, R.; R.F. Luck; J.H. Werren (1992) **Genetics of sex determination and the improvement of biological control using parasitoids.** *Environmental Entomology.* 21(3): 427-435. ISSN: 0046-225X.
NAL Call Number: QL461.E532

Abstract: Diploid males are known to occur in several braconid and ichneumonid species. These diploid males are the result of a single-locus, sex-determination mechanism. Heterozygotes at this sex locus develop into females, whereas hemizygotes (haploids) and homozygotes (diploids) develop into males. Diploid males have a low fertility and their frequency drastically increases with small populations or inbreeding. The implications of this sex-determining mechanism for the use of parasitoids in biological control are explored. Production of diploid males leads to male-biased sex ratios and can reduce rates of establishment and population growth. Taxa in which a single-locus sex determination has been found (e.g., Ichneumonidae and Braconidae) often experience extreme male-biased sex ratios in mass rearing and have been more difficult to establish than taxa with other modes of sex determination (e.g., Chalcidoids). The effect of laboratory rearing on the number of sex alleles, frequency of diploid males, and population growth rates is explored by computer simulation. Methods of rearing and release that can enhance the number of sex alleles and the establishment of parasitoids are discussed. Furthermore, additional small-scale releases may enhance the effectiveness of already established populations by increasing number of sex alleles and the rate at which their population grows.
Descriptors: Braconidae, Ichneumonidae, biological control agents, diploidy, genetic variation, laboratory rearing, parasites of insect pests, population genetics, sex determination, sex ratio, simulation models, Hymenoptera.

1991

Hagley, E.A.; Barber, D.R. (1991) **Mortality, fecundity and longevity of parasitoids of the spotted tentiform leafminer, *Phyllonorycter blancardella* (Lep.: Gracillariidae) at constant temperatures in the laboratory.** *Entomophaga.* 36(3): 409-415. ISSN: 0013-8959.
NAL Call Number: 421 En835
Descriptors: pests, natural enemies, mortality, temperature effect, fecundity, environmental factors, parasitoids, insect hosts, *Pnigalio flavipes*, Lepidoptera, Gracillariidae, Hymenoptera, Eulophidae, *Sympiesis sericeicornis*, *Sympiesis marylandensis*, *Pholetesor ornigis*, *Phyllonorycter blancardella*, Eulophidae, *Pholetesor*, Braconidae, biological control.

1990

Hamerski, M.R.; Hall, R.W.; Keeney, G.D. (1990) **Laboratory biology and rearing of *Tetrastichus brevistigma* (Hymenoptera: Eulophidae), a larval-pupal parasitoid of the elm leaf beetle (Coleoptera: Chrysomelidae).** *Journal of Economic Entomology.* 83(6): 2196-2199. ISSN: 0022-0493.
NAL Call Number: 421 J822
Descriptors: forest insect pests, natural enemies, diapause, photoperiod, rearing techniques, parasitoids, hosts, environmental factors, biological control, *Tetrastichus brevistigma*, Coleoptera, Hymenoptera, *Pyrrhalta luteola*, Spermatophyta, silviculture, pest and parasite management.

Mead, F.; Pratte, M.; Gabouriaut, D. (1990) **Influence of a difference in the temperature and day duration on the progression of the life of a society of *Polistes dominulus* Christ (Hymenoptera: Vespidae) reared in the laboratory.** *Insectes Sociaux.* 37(3): 236-250. ISSN: 0020-1812.
NAL Call Number: 421 IN79
Descriptors: predators, temperature, photoperiod, natural enemies, developmental biology, ecology, *Polistes dominulus*, Vespidae, Hymenoptera, biological control, insect reproduction.

Ridgway, N.M.; Mahr, D.L. (1990) **Reproduction, development, and longevity of *Pholetesor ornigis* (Hymenoptera: Braconidae), a parasitoid of spotted tentiform leafminer (Lepidoptera: Gracillariidae), in the laboratory.** *Annals of the entomological Society of America.* 83(4): 790-794. ISSN: 0013-8746.
NAL Call Number: 420 En82
Descriptors: reproduction, development, longevity, parasitoid, laboratory study, temperature, photoperiod, insect pest, fruit trees, entomophagous, environmental factor, biological control, *Malus domestica*, *Pholetesor ornigis*, *Phyllonorycter blancardella*, Rosaceae, Hymenoptera, Lepidoptera, leafminer.

Ridgway, N.M.; Mahr, D.L. (1990) **Reproduction, development, longevity, and host mortality of *Sympiesis marylandensis* (Hymenoptera: Eulophidae), a parasitoid of spotted tentiform leafminer (Lepidoptera: Gracillariidae), in the laboratory.** *Annals of the Entomological Society of America.* 83(4): 795-799. ISSN: 0013-8746.
NAL Call Number: 420 EN82
Descriptors: pests, natural enemies, developmental biology, reproduction, honeydew, temperature, apples, parasitoids, insect hosts, Lepidoptera, Hymenoptera, *Aphis pomi*, *Phyllonorycter blancardella*, *Sympiesis marylandensis*, *Malus*, *Sternorrhyncha*, Homoptera, Hemiptera, biological control, animal wastes, insect pests of plants.

1989

Fabre, J.P.; Chalon, A.; Robert, R.; Chizky, J. (1989) **Laboratory rearing tests of *Pauesia cedrobii* (Hym.: Aphidiidae), a parasite of the aphid: *Cedrobium laportei* (Hom.: Lachnidae) of the Atlas cedar.** *Entomophaga.* 34(3): 381-389. ISSN: 0013-8959.
NAL Call Number: 421 En835
Descriptors: insect rearing, temperature, photoperiod, population dynamics, insect pest, parasite, entomophagous, environmental factor, Homoptera, Hymenoptera, Atlas cedar.

Rutz, D.A.; G.A. Scoles (1989) **Occurrence and seasonal abundance of parasitoids attacking muscoid flies (Diptera: Muscidae) in caged-layer poultry facilities in New York.** *Environmental entomology.* 18: 51-55. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Abstract: Five species of house fly pupal parasitoids, *Nasonia vitripennis walker*, *Muscidifurax raptor girault* and *sanders*, *Pachycrepoideus vindemiae* (*rondani*), *Spalangia* sp., and *Apanteles carpatus* (*say*), were recovered from house fly pupae exposed in controlled-environment, caged-layer poultry facilities during a 17-mo New York statewide survey. Overall, rates of parasitism were low, ranging from 0.2% in early

spring to 14.0% in the fall. The number of fly pupae attacked by *N. vitripennis* was significantly higher than those killed by the other parasitoid species. Of all parasitized pupae collected in 1981, 76.9% were killed by *N. vitripennis*. In 1982, *N. vitripennis* was responsible for killing nearly 94.8% of all parasitized pupae. *N. vitripennis* was also the most abundant parasitoid, accounting for 95.5 and 99.2% of all parasitoids emerging from sentinel pupae during 1981 and 1982, respectively. In addition, *N. vitripennis* was the only parasitoid species observed to actively parasitize fly pupae in these facilities during cold winter months when temperatures in the first-floor manure pits ranged from 12 to 16 degrees C. All the other parasitoid species generally were active only during warm summer months.
Descriptors: poultry, *Musca domestica*, pupae, *Nasonia vitripennis*, *Muscidifurax raptor*, *Pachycrepoideus vindemiae*, *Spalangia*, *Apanteles*, parasites of insect pests, biological control, seasonal variation, New York.

1988

Jones, T.H.; Hassell, M.P. (1988) **Patterns of parasitism by *Trybliographa rapae*, a cynipid parasitoid of the cabbage root fly, under laboratory and field conditions.** *Ecological entomology.* 13(3): 309-317. ISSN: 0307-6946.
NAL Call Number: QL461 E4
Descriptors: parasitism, population density, comparative study, environmental factors, spatial distribution, study under natural conditions, laboratory study, entomophagous, parasite, host-parasite relation, Cynipidae, *Delia radicum*, parasitoid, Hymenoptera, Diptera.

Leisse, N.; Sengonca, C. (1988) **Laboruntersuchungen auf der Biologie und dem Niveau von Parasitismus von *Trichogramma semblidis* (*auriv.*) als Ei parasitoid von *Eupoecilia ambiguella hb*. [Laboratory investigations on the biology and level of parasitism of *Trichogramma semblidis* (*auriv.*) as an egg parasitoid of *Eupoecilia ambiguella hb.*]** *Mitteilungen der Deutschen Gesellschaft fur Allgemeine und Angewandte Entomologie.* 6(1-3): 238-242. ISSN: 0344-9084. Note: In German.
NAL Call Number: QL461 M68
Descriptors: natural enemies, rearing techniques, temperature, insect pests, grapes, parasitoids, hosts, environmental factors, fruits, techniques, German Society for General and Applied Entomology, Lepidoptera, Hymenoptera, *Eupoecilia ambiguella*, Rhamnales, insect pests of plants, techniques and methodology, biological control.

1986

Gautam, R.D. (1986) **Effect of different temperatures and relative humidities on the efficiency of parasitoid, *Telenomus remus nixon* (Scelionidae: Hymenoptera) in the laboratory.** *Journal of Entomological Research.* 10(1): 34-39. ISSN: 0378-9519.
NAL Call Number: QL483.I4J6
Descriptors: natural enemies, temperature and relative humidity effects, insect hosts, environmental factors, Lepidoptera, Noctuidae, *Spodoptera litura*, *Telenomus remus*, Scelionidae, Hymenoptera, biological control, parasitoid efficiency.

1985

Thorpe, K.W.; Dively, G.P. (1985) **Effects of arena size on laboratory evaluations of the egg parasitoids *Trichogramma minutum*, *T. pretiosum*, and *T. exiguum* (Hymenoptera: Trichogrammatidae).** *Environmental Entomology.* 14(6): 762-767. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: natural enemies, egg parasitoids, insect host ecology, environmental factors, eggs, biological control, Lepidoptera, Noctuidae, *Heliothis virescens*, *Trichogramma minutum*, *Trichogramma pretiosum*, *Trichogramma exiguum*, Hymenoptera, biological control insects, USA.

1983

Walter, S. (1983) **Biologische und ökologische Untersuchungen über Eiparasiten der Klasse *Trichogramma westwood* (Hym., Chalc.). II: Untersuchungen durchgeführt worden unter Laborzuständen. [Biological and ecological studies on egg parasites of the genus *Trichogramma westwood* (Hym., Chalc.). II: Investigations carried out under laboratory conditions.]** *Zoologische Jahrbuecher. Abteilung fuer Systematik,Oekologie und Geographie der Tiere.* 110(4): 419-441. ISSN: 0044-5193. Note: In German.
NAL Call Number: 410 Z751S
Descriptors: Hymenoptera, egg parasitoid, fecundity, population productivity, host-parasite relations, environmental factors, Lepidoptera, laboratory study, Chalcididae, *Trichogramma*, *Mamestra brassicae*, *Sitotroga cerealella*, Noctuidae.

1973

Ferran, A.; Laforge, J.P. (1973) **L'élevage dans le laboratoire sur un centre serveur de remplacement du flavitestacea de Phanerotoma (Hym. Braconidae) s'est rassemblé en environnement normal : les effets sur le potentiel biotique de l'espèce. [The rearing in the laboratory on a substitute host of *Phanerotoma flavitestacea* (Hym. Braconidae) collected in a natural environment: the effects on the biotic potential of the species.]** *Entomophaga.* 18(4): 397-403. ISSN: 0013-8959. Note: In French.
NAL Call Number: 421 En835
Descriptors: insect hosts, biological control agents, natural enemies, parasitoids, biotic potential, substitute hosts, *Ectomyelois ceratoniae*, *Phanerotoma flavitestacea*, *Ephestia kuehniella*, Pyralidae, Lepidoptera, Braconidae, Hymenoptera, France.

1971

Stary, P. (1971) **Laboratory adaptation of *Aphidius smithi sharma* and *subba rao* (Hym. Aphidiidae) to cooler environments.** *Bollettino del Laboratorio di Entomologia Agraria Filippo Silvestri, Portici.* 28: 19-34. ISSN: 0304-0658.
NAL Call Number: 420 P82B
Descriptors: natural enemies, low temperature adaptation, *Aphidius smithi*, Braconidae, Hymenoptera, biological control, insect pests of plants.

Orthoptera

1999

Fisher, J.R.; W.P. Kemp; F.B. Pierson (1999) **Postdiapause development and prediction of hatch of *Ageneotettix deorum* (Orthoptera: Acrididae).** *Environmental entomology.* 28(3): 347-352. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Abstract: Phenological predictions of life stages of rangeland grasshoppers can be improved with models that predict egg hatch. We investigated the postdiapause development and hatch of the grasshopper *Ageneotettix deorum* (*scudder*) in the grasslands of southwest Montana during a 3-yr period. Postdiapause embryonic development rates were estimated by exposing eggs to 12 different constant temperature regimes from 9 to 42 degrees C. We used the population model design system to generate a development rate function and to predict hatch at one site in southwestern Montana for 3 yr and at another site in southwestern Montana for 2 yr. When estimated hatch was compared with field occurrence of 1st instars, the 50% occurrence dates were very similar; within 2.0 +/- 1.8d for all 5 comparisons. The results of our investigations should enhance the ability of decision support systems for grasshopper management to provide forecasts to land managers and pest advisors.
Descriptors: *Ageneotettix deorum*, diapause, embryonic development, hatch, phenology, environmental temperature, survival, rangeland grasshopper, computer simulation, models, prediction, Montana.

1994

Haschemi, H. (1994) **Untersuchungen über die Kalttoleranz der unterschiedlichen Belastungen des deutsche Schabe *Blatella germanica* (*l.*) (Blattodea, Blattidae) unter Labor bedingt. [Studies on the cold-tolerance of different strains of the German cockroach *Blatella germanica* (*l.*) (Blattodea, Blattidae) under laboratory conditions.]** *Anzeiger fuer Schadlingskunde, Pflanzenschutz, Umweltschutz.* 67(2): 25-30. ISSN: 0340-7330. Note: In German.
NAL Call Number: 421 An9
Descriptors: strain, cold, tolerance, laboratory study, intraspecific comparison, *Blattella germanica*, Dictyoptera, environmental factor, physical environment, strain differences.

1983

Ballard, J.B. (1983) **Assessment of ecological parameters and trap designs which influence the capture of German cockroaches in laboratory and urban environments.** *Dissertation Abstracts International B Sciences and Engineering.* 43(11): 3472-3473. ISSN: 0419-4217.
NAL Call Number: Z5055 U49D53

Descriptors: *Blattella germanica*, trap design evaluation, population density and dynamics, influences on catch, abiotic factors, laboratory urban habitats, collecting techniques, ecology, Dictyoptera.

1979

Chisholm, I.F. (1979) **A Laboratory investigation of *Paulinia acuminata* (*degeer*) (Orthoptera: Acrididae) as a biological control agent for *Salvinia molesta*.** *Bulletin of entomological research.* 69(1): 111-114. ISSN: 0007-4853.
NAL Call Number: 421 B87
Descriptors: Acrididae, food intake, laboratory study, biological control, weeds, freshwater environment, nymph, Orthoptera, phytophagous insects, ecology, Africa.

Miscellaneous

2004

Romeis, J.; Dutton, A.; Bigler, F. (2004) ***Bacillus thuringiensis* toxin (Cry1Ab) has no direct effect on larvae of the green lacewing Chrysoperla carnea (Stephens) (Neuroptera: Chrysopidae).** *Journal of Insect Physiology.* 50(2-3): 175-183. ISSN: 0022-1910.
NAL Call Number: 421 J825
Descriptors: agronomy, economic entomology, molecular genetics, biochemistry, molecular biophysics, pest assessment control and management, terrestrial ecology, toxicology, *Bacillus thuringiensis,* biocontrol agent, transgenic maize, lepidopteran prey, *Chrysoperla carnea,* green lacewing, Neuroptera, larva, Chrysopidae, predator, Cry1Ab toxin, genetic and laboratory techniques, prey quality, environmental biology.

2002

Ode, P.J.; Heinz, K.M. (2002) **Host-size-dependent sex ratio theory and improving mass-reared parasitoid sex ratios.** *Biological Control.* 24(1): 31-41. ISSN: 1049-9644.
NAL Call Number: SB925.B5
Descriptors: *Liriomyza huidobrensis*, leafminers, *Diglyphus isaea*, host size dependent sex ratio theory, augmentative biological control, Diptera, *Diglyphus begini*, hymenoptera, individual decisions, patchy environment, field populations, *Trifolii diptera*, Agromyzidae, egg parasitoid, wasp, laboratory study.

2001

Thomson, L.J.; Robinson, M.; Hoffmann, A.A. (2001) **Field and laboratory evidence for acclimation without costs in an egg parasitoid.** *Functional Ecology.* 15(2): 217-221. ISSN: 0269-8463.
NAL Call Number: QH540.F85
Descriptors: parasitoid wasp, insect pest assessment control and management, Hymenoptera, Lepidoptera, *Trichogramma carverae*, adult, pupa, moth, egg, host,

acclimation responses, fitness benefits and costs, heat hardening and resistance, parasitism rates, temperature shock, comparative study.

2000

Mesa, C. (2000) **Reconocimiento de insectos y caros Depredadores [Recognition of insects and expensive Predators].** *1. Curso Taller Internacional Control Biologico CORPOICA*, Santaf de Bogot (Colombia): 66-67. Notes: Doc. 19348, In Spanish. Descriptors: biological control, mass rearing, *Trichogramma*, *Telenomus*, *Brachymeria*, *Copidosoma*, environmental factors, Hymenoptera, mass rearing techniques.

1999

Hogsette, J.A. (1999) **Management of ectoparasites with biological control organisms.** *International journal for parasitology.* 29(1): 147-151. ISSN: 0020-7519.
NAL Call Number: QH547.I55
Abstract: Biological control is not a new concept, but for many reasons it is gaining interest for control of livestock ectoparasites. These reasons will be discussed, both from a political view and from environmental and economic views. The US government has vowed to reduce pesticide use by the year 2000, but other forces may drive this change even faster. Pesticide costs are high, and efficacy against some pests is questionable. Also, many producers are concerned about the environment, and are anxious to do their part to reduce chemical pollution. Specialised training is required to reduce on-the-farm difficulties involved with the use of biological control organisms. Otherwise, how do producers or veterinarians purchase and use biocontrol organisms, and how do they critique what has been purchased? Included is a short summary of the three most common ectoparasites of livestock, and the type of biological-control strategies being developed to combat them. Much of the classical work has been done on filth fly control, most likely because of the nuisance status of flies, and because of the availability of candidate beneficial organisms, particularly parasitic wasps. And finally, two fly-control success stories will be briefly described. Tremendous strides have been made in house-fly and stable-fly control with parasitic wasps on feedlots, but more work is needed to better understand the habits of immature fly populations. A predaceous fly is being tested for pest fly control in dairies. Larvae of this fly can kill 15-20 house-fly larvae daily, and the adults do not become pestiferous on farms or around homes. Biological control will be an important part of livestock pest control in the future, but its implementation will require a corps of educated producers who are confident that biological control can work for them.
Descriptors: *Musca domestica*, *Stomoxys calcitrans*, parasites of insect pests, predators of insect pests, natural enemies, biological control agents, literature reviews.

1998

Mracek, Z.; Becvar, S.; Kindlmann, P.; Webster, J.M. (1998) **Infectivity and specificity of Canadian and Czech isolates of *Steinernema kraussei* (Steiner, 1923) to some insect pests at low temperatures in the laboratory.** *Nematologica.* 44(4): 437-448. ISSN:

0028-2596.
NAL Call Number: 436.8 N342
Descriptors: insect isolates, geographical variation, Czech Republic, Canada, host specificity, entomopathogen, room temperature, mortality, parasitism efficiency, laboratory study, environmental factor, biological control agents, Nematoda, Europe.

Senior, L.J.; McEwen, P.K. (1998) **Laboratory study of *Chrysoperla carnea* (*stephens*) (Neuropt., Chrysopidae) predation on *Trialeurodes vaporariorum* (*westwood*) (Hom., Aleyrodidae).** *Journal of applied entomology.* 122(2-3): 99-101. ISSN: 0931-2048.
NAL Call Number: 421 Z36
Descriptors: pest management, biological control agent, predator-prey relation, laboratory study, supplemented diet, developmental stage, longevity, *Chrysoperla carnea*, *Trialeurodes vaporariorum*, protected cultivation.

1997

Armitage, D.M.; Cook, D.A. (1997) **Laboratory experiments to compare the development of populations of five species of insect during dormancy break and subsequent cool storage of malting barley.** *Journal of the Institute of Brewing.* 103(4): 245-249. ISSN: 0046-9750.
NAL Call Number: 390.9 In7
Descriptors: insect population dynamics, temperature effect, refrigerated storage effects, infestation, dormancy breaking, pest management, cooling, survival rates, *Cryptolestes ferrugineus*, *Hordeum vulgare*, *Oryzaephilus surinamensis*, *Rhyzopertha dominica*, *Sitophilus granaries*, *Trogoderma granarium*, malting barley, laboratory study, Cucujidae, Coleoptera, Gramineae, Bostrychidae, Curculionidae, Dermestidae.

1992

Hesler, L.S.; A.A. Grigarick (1992) **Aquatic arthropods in California rice paddies: effects of water-drainage versus continuous-flood regimes on abundance and species composition.** *Environmental entomology.* 21(4): 731-736. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Abstract: In conjunction with experiments to evaluate water drainage as a control method for the rice water weevil, *Lissorhoptrus oryzophilus kuschel*, studies were performed to compare, the abundance and species composition of aquatic arthropods in two sets of continuously flooded and temporarily drained but reflooded rice, *Oryza sativa l.*, paddies. A total of 1,736 individuals representing 22 arthropod taxa was collected. Few differences in abundance were detected; however, *Notonecta* spp. were significantly more abundant in reflooded paddies. Percentage similarity (PS) between paired treatments was > 0.50 on all but one date; relatively high PS values on the first sampling dates suggest that the aquatic arthropod community is able to recover rapidly following reflooding. Several taxa appear to possess traits that enhance survival in a rice paddy subjected to temporary drainage. Implications are discussed for the wide-scale use of drainage on California rice acreage.
Descriptors: *Oryza sativa*, *Lissorhoptrus oryzophilus*, notonecta, rice, drained conditions,

surveys, sampling, California.

Lytvyn, V.; Y. Fortin; M. Banville; B. Arif; C. Richardson (1992) **Comparison of the thymidine kinase genes from three entomopoxviruses.** *The Journal of general virology.* 73(12): 3235-3240. ISSN: 0022-1317.
NAL Call Number: QR360.A1J6
Abstract: The entomopoxviruses (insect poxviruses) of eastern spruce budworm (*Choristoneura fumiferana*), two year cycle spruce budworm (*C. biennis*) and the Indian red army worm (*Amsacta moorei*) are being studied in our laboratory for their potential as biological insecticides and expression vectors. These viruses characteristically replicate in the cytoplasm of insect cells and produce occlusion bodies that serve to protect the virion from the environment. By analogy to mammalian poxviruses, they should also contain a viral thymidine kinase (TK) that functions in viral DNA synthesis. The replication of the *A. moorei* entomopoxvirus was inhibited by bromodeoxyuridine whereas the baculovirus of *Autographa californica* was insensitive to this drug. This result was a biochemical indication that entomopoxviruses contained a kinase that phosphorylated this nucleoside analogue and thus viral DNA synthesis was inhibited. TK genes from the three different insect poxviruses were identified, cloned and sequenced. The sequences of the TK genes of the entomopoxviruses were closely related and exhibited 63.2% identity and 9.9% similarity at the protein level. However, there was only 36.7% identity and 13.6% similarity when these enzymes were compared to their mammalian poxvirus counterpart in vaccinia virus. Finally, one entomopoxvirus TK gene was expressed in *Escherichia coli* mutants lacking the enzyme. These bacteria were converted to a phenotype that could incorporate radioactive thymidine into their chromosomal DNA. The results presented in this paper provide impetus for the design of a recombinant entomopoxvirus expression system in which foreign genes could be introduced into the viral TK locus under selective pressure from bromodeoxyuridine.
Descriptors: *Choristoneura fumiferana*, *Choristoneura biennis*, *Amsacta moorei*, entomopoxvirus, genes, thymidine kinase, DNA, clones, nucleotide sequences, amino acid sequences, bromodeoxyuridine, possible recombinant entomopoxvirus expression system.

1990

Lei, H.; Yue, B.; Huang, L. (1990) **[Influence of humidity and host plants on the growth of laboratory population of citrus black scale (*Parlatoria zizyphus lucas*).]** *Journal of Southwest Agricultural University.* 12(4): 349-352. ISSN: 1000-2642. Notes: 1 ill., 4 tables, 3 ref., In Chinese.
NAL Call Number: S471.C62S68
Descriptors: citrus, hosts, *Parlatoria*, species, insect population, variations, relative humidity, survival, death, longevity, mortality, oviposition, hatching, developmental stages, chemicophysical properties, *Coccoidea*, Diaspididae, ecology, Hemiptera, Homoptera, humidity, parasitism, physiological functions, Rutaceae, sexual reproduction.

1985

Hassell, M.P.; Lessells, C.M.; McGavin, G.C. (1985) **Inverse density dependent parasitism in a patchy environment: a laboratory system.** *Ecological Entomology.* 10(4): 393-402.
ISSN: 0307-6946.
NAL Call Number: QL461.E4
Descriptors: natural enemies, parasites, hosts, ecology, population dynamics, *Heterospilus prosopidis*, Coleoptera, Hymenoptera, *Callosobruchus chinensis*, *Anisopteromalus calandrae*, Bruchidae, Pteromalidae, biological control agent.

1975

Pasqualini, E. (1975) **Prove sull'elevazione dello steph di carnea di Chrysopa. (Neuroptera, Chrysopidae) sugli ambienti climatizzati. [Trials on rearing *Chrysopa carnea steph*. (Neuroptera, Chrysopidae) on climatized environments.]** *Bollettino dell'Istituto di Entomologia dell'Universita degli Studi di Bologna.* 32: 291-304. ISSN: 0373-5176.
Notes: 3 tables; 4 illus.; 46 ref., In Italian.
Descriptors: biocontrol, rearing techniques, environmental factors, temperatures, humidity.

Toxicology Related Resources

Diptera

2004

Choi, J.; Roche, H. (2004) **Effect of potassium dichromate and fenitrothion on hemoglobins of Chironomus riparius Mg. (Diptera, Chironomidae) larvae: Potential biomarker of environmental monitoring.** *Environmental Monitoring and Assessment.* 92(1-3): 229-239. ISSN: 0167-6369.
URL: http://www.kluweronline.com/issn/1420-2026/contents
NAL Call Number: TD194 .E5
Descriptors: blood and lymphatics, transport and circulation, pollution assessment control and management, toxicology, Diptera, *Chironomus riparius,* chromium, toxin, fenitrothion, hemoglobin, potential biomarker, autoxidation, potassium dichromate, cyanomethemoglobin procedure, laboratory techniques, electrophoresis, environmental monitoring, isoelectric focusing, electrophoretic techniques, multi-wavelength rapid-scanning spectrophotometry, spectrum analysis techniques, redox-active chemical exposure, proteins, peptides and amino acids, porphyrins and bile pigments, toxicology.

Trumble, J.T.; Jensen, P.D. (2004) **Ovipositional response, developmental effects and toxicity of hexavalent chromium to *Megaselia scalaris*, a terrestrial detritivore.** *Archives of Environmental Contamination and Toxicology.* 46(3): 372-376. ISSN: 0090-4341.
NAL Call Number: TD172 A7
Descriptors: development, terrestrial ecology, toxicology, Diptera, *Megaselia scalaris,* adult, egg, larva, female and male development, larval survival, ovipositing and ovipositional response, survival, terrestrial detritivore, hexavalent chromium, developmental effects, toxicity, laboratory experimentation and techniques, artificial diets, avoidance behavior, developmental times, eclosion rates, survivorship, embryology, comparative study, experimental morphology, physiology, pathology.

2001

Burdett, A.S.; Stevens, M.M.; Macmillan, D.L. (2001) **Laboratory and field studies on the effect of molinate, clomazone, and thiobencarb on nontarget aquatic invertebrates.** *Environmental toxicology and chemistry.* 20(10): 2229-2236. ISSN: 0730-7268.
NAL Call Number: QH545.A1E58
Descriptors: non-target organism, herbicide toxicity, laboratory study, larva, development, concentration effect, field study, freshwater pond community structure, ecological abundance, comparative study, risk analysis, water pollution, pesticides, carbamate, isoxazole derivatives, Chironomidae, Diptera.

Henry, K.S.; Wieland, W.H.; Powell, D.E.; Giesy, J.P. (2001) **Laboratory analyses of the potential toxicity of sediment-associated polydimethylsiloxane to benthic**

macroinvertebrates. *Environmental toxicology and chemistry.* 20(11): 2611-2616. ISSN: 0730-7268.
NAL Call Number: QH545.A1E58
Descriptors: freshwater ecology, environmental biology, toxic pollution assessment and control, Diptera, Malacostraca, *Chironomus tetans*, larva, midge, *Hyalella azteca*, amphipod, polydimethylsiloxane, degradation rate, down-the-drain disposal, log p value, physicochemical characteristics, sediment testing, short-term exposure, whole-life-cycle exposure, methods, life-cycle assay endpoints, emergence, growth, reproduction, survival rates.

2000

Dawson, T.D.; Jenson, J.J.; Norberg-King, T.J. (2000) **Laboratory culture of *Chironomus tentans* for use in toxicity testing: Optimum initial egg-stocking densities.** *Hydrobiologia.* 438: 251-256. ISSN: 0018-8158.
NAL Call Number: 410 H992
Descriptors: toxic pollution assessment control and management, Diptera, *Chironomus tentans*, life stages bioindicator, egg, sediment toxicity testing, monitoring method, adult emergence, body length, ecotoxicology, feeding rate, laboratory conditions, larval weight, stock density, survival, developmental biology.

Xue, R.D.; Barnard, D.R.; Ali, A. (2000) **Laboratory toxicity of three mosquito oviposition repellents to six nontarget aquatic invertebrates.** *Environmental entomology.* 29(3): 437-441. ISSN: 0046-225X.
NAL Call Number: QL461.E532
Descriptors: laboratory study, egg laying, repellent effects, ectoparasite, toxicity, non target organisms, mortality, *Chironomus decorus*, *Toxorhynchites amboinensis*, freshwater environment, benzenic compound, Diptera.

Yee, K.A.; Prepas, E.E.; Chambers, P.A.; Culp, J.M.; Scrimgeour, G. (2000) **Impact of $Ca(OH)_2$ treatment on macroinvertebrate communities in eutrophic hardwater lakes in the Boreal Plain region of Alberta: in situ and laboratory experiments.** *Canadian journal of fisheries and aquatic sciences.* 57(1): 125-136. ISSN: 0706-652X.
NAL Call Number: 442.9 C16J
Descriptors: calcium hydroxide chemical treatment, population density, species diversity, insect community, macrofauna, zoobenthos, hard water, eutrophication, lakes, Alberta, field and laboratory studies, *Hyalella azteca*, *Chironomus*, freshwater environment, Amphipoda, Crustacea, Diptera, Canada.

1999

Amalraj, D.D., Sivagnaname, N., Srinivasan, R. (1999) **Susceptibility of *Phlebotomus argentipes* and *P. papatasi* (Diptera: Psychodidae) to insecticides.** *The Journal of communicable diseases.* 31(3): 177-80. ISSN: 0019-5138.
NAL Call Number: RA643.7 I6

Abstract: Field collected fully fed adults of *Phlebotomus argentipes* and *P. papatasi* were screened in the laboratory for susceptibility to DDT, BHC, malathion, deltamethrin, permethrin, lambdacyhalothrin and bendiocarb. Pondichery strain of *P. papatasi* and *P. argentipes* showed variations in their susceptibility to insecticides. Both the species were resistant to permethrin but tolerant to DDT and malathion with LD99.99 values of 13.88, 1.92, 1.08 and 34.63, 4.69, 16.32 times more than the deterministic doses respectively. However, they were susceptible to bendiocarb with LD99.99 7.6 and 1.6 times lower than the deterministic doses. While *P. papatasi* was susceptible to BHC, *P. argentipes* showed tolerance (1.6 times). The former showed tolerance to deltamethrin and the latter exhibited resistance (34 times). It was reverse in case of lamdacyhalothrin. High susceptibility of the vector sandflies to bendiocarb suggests that this insecticide could be used effectively against OP and pyrethroid resistant populations for Kalaazar control.
Descriptors: insecticides, pharmacology, *Phlebotomus*, drug-resistance, DDT, BHC, malathion, deltamethrin, permethrin, lambdacyhalothrin, bendiocarb, pest control.

Conrad, A.U.; Fleming, R.J.; Crane, M. (1999) **Laboratory and field response of *Chironomus riparius* to a pyrethroid insecticide.** *Water Research (United Kingdom).* 33(7): 1603-1610. ISSN: 0043-1354.
NAL Call Number: TD420.W3
Descriptors: permethrin, drug toxicity, pyrethroid, insecticide toxicity testing, water pollution, biological monitoring, Chironomidae, sediment, bioassay, standardization, environmental monitoring, law, CAS Registry Number: 51877-74-8, 52645-53-1, environmental health and pollution control.

Tucker, K.A.; Burton, G.A. Jr. (1999) **Assessment of nonpoint-source runoff in a stream using in situ and laboratory approaches.** *Environmental Toxicology and Chemistry.* 18(12): 2797-2803. ISSN: 0730-7268.
NAL Call Number: QH545.A1E58
Descriptors: water runoff analysis, toxicity testing, etiology, analytic methods, Chironomidae, environmental exposure, benthic environment, laboratory experiment, controlled study, tissues, newborn, environmental health, pollution control.

1997

Kence, M.; T. Jdeidi (1997) **Effect of malathion on larval competition in house fly (Diptera: Muscidae) populations.** *Journal of economic entomology.* 90(1): 59-65. ISSN: 0022-0493.
NAL Call Number: 421 J822
Abstract: We studied the competitive abilities of 2 strains of house flies, *Musca domestica l*., A14/WHO, a strain heterozygous for resistance gene(s), and bwb, a susceptible strain, at 4 densities 450, 900, 1,800, and 3,600 eggs per 100 g of medium in pure and mixed cultures in the absence and presence of malathion. Both genotypes exhibited lower survival, lower mean adult weight, and longer developmental time as the density increased in an environment free of insecticide. There was a relative advantage of A14/WHO strain when mixed with bwb at densities >450/100 g. At high densities, bwb in mixed culture was at a disadvantage relative to its performance in pure culture. In an environment with insecticide only the males of the A14/WHO strain survived. During

these experiments, we observed a parabolic relationship between the egg density and the number of emerging adults in control experiments without malathion treatment. When cultures were treated with malathion, however, this relationship became linear and number of emerging adults increased with egg density. Malathion treatment reduced the intensity of larval competition at high densities by killing part of the population, thereby increasing yield. Malathion treatment also caused the emergence of much heavier flies. Descriptors: *Musca domestica*, malathion insecticide, larvae, competitive ability, intraspecific competition, insecticide resistance, biocontrol, pure and mixed cultures, population density, crowding, survival, body weight, biological development, sex ratio.

1996

Freebairn, K.; J.L. Yen; J.A. McKenzie (1996) **Environmental and genetic effects on the asymmetry phenotype: diazinon resistance in the Australian sheep blowfly, *Lucilia cuprina*.** *Genetics.* 144(1): 229-239. ISSN: 0016-6731.
NAL Call Number: 442.8 G28
Abstract: The asymmetry phenotype of diazinon-resistant flies lacking a fitness/asymmetry Modifier (+/+; R/-) was dominant and independent of developmental temperature, larval density and diazinon concentration. Asymmetry score, pooled over three bristle characters, was approximately 50% greater for these phenotypes than for those of modified genotypes (M/-; -/-) and unmodified susceptibles (+/+; S/S) reared under standard laboratory conditions. Modified and susceptible phenotypes showed increased asymmetry score for temperatures and larval densities above and below standard rearing conditions; a positive correlation was observed between diazinon concentration and asymmetry score. Single and multiple environmental stresses resulted in similar scores that approached, but never exceeded, those of unmodified resistant phenotypes. Irrespective of the developmental conditions anti-symmetry and fluctuating asymmetry were typically observed for each bristle character of unmodified resistant and the modified and susceptible phenotypes, respectively. Thus while similar asymmetry scores could arise from genetic or environmental effects, asymmetry pattern was genetically based. Population cage analyses at different temperatures and larval densities showed a negative association between mean asymmetry and relative fitness.
Descriptors: *Lucilia cuprina*, genetic effects, diazinon insecticide resistance, genotype environment interactions, alleles, air temperature, population density, bristles, phenotypes, biological development, larvae, asymmetry, environmental factors.

1995

McKenzie, J.A.; J.L. Yen (1995) **Genotype, environment and the asymmetry phenotype. Dieldrin-resistance in *Lucilia cuprina* (the Australian sheep blowfly).** *Heredity.* 75(2): 181-187. ISSN: 0018-067X.
NAL Call Number: 443.8 H42
Abstract: Dieldrin-resistant (Rdl/Rdl and Rdl/+) and susceptible (+/+) phenotypes of *Lucilia cuprina* were scored for departures from bilateral symmetry for bristle characters after development at different temperatures, larval densities or concentrations of dieldrin. The asymmetry phenotype of resistant flies was dominant and independent of

developmental temperature and larval density. The asymmetry of susceptibles increased for temperatures and larval densities above and below standard rearing conditions. A positive correlation was observed between asymmetry score and dieldrin concentration for all genotypes. The susceptible phenotype did not attain the asymmetry score of resistants in any environment. Resistant phenotypes showed an antisymmetric pattern in each environment; fluctuating asymmetry was observed for susceptibles. The relevance of the results of genetic and general or specific environmental stresses to estimates of developmental perturbation is discussed.
Descriptors: *Lucilia cuprina*, genotypes, phenotypes, dieldrin insecticide resistance, susceptibility, bristles, wings, morphology, population density, larvae, environmental temperature, genotype/ environment interactions.

1994

Nestrud, L.B.; R.L. Anderson (1994) **Aquatic safety of *Lagenidium giganteum*: effects on freshwater fish and invertebrates.** *Journal of invertebrate pathology.* 64(3): 228-233. ISSN: 0022-2011.
NAL Call Number: 421 J826
Abstract: Eleven freshwater species were exposed to a zoospore-producing fungus, *Lagenidium giganteum*, with the goal of determining species sensitivity with standard and new test procedures. The tests included standard, 4-day acute exposures of cladocerans (*Ceriodaphnia dubia*, *Daphnia pulex*, and *D. magna*) and the fathead minnow (*Pimephales promelas*). Standard 7-day chronic exposures of *C. dubia* and a 7-day embryo-larval exposure of *P. promelas* were also conducted. New, 4-day acute, methods were developed for mosquitos (*Aedes aegypti*), chironomids (*Chironomus* sp.), oligochaetes (*Lumbriculus* sp.), cyclopoid copepods, snails (*Physa* sp.), hydrozoans (*Hydra* sp.), and ostracods. To assess *L. giganteum* zoospore (z) infectivity, each test included daily bioassays with the mosquito (*A. aegypti*), a target organism. Four-day *A. aegypti* LC50s ranged from 81 to 516 z/ml. *Ceriodaphnia dubia* acute test LC50S were as low as 6700 z/ml and the 96-hr LC50 from the chronic test was near 6250 z/ml with reproductive impairment at 12,500 z/ml. *Daphnia* sp. were also susceptible, with LC50s near 7700 z/ml for *D. pulex* and 9400 z/ml for *D. magna*. *Chironomus tentans* was infected at concentrations of greater than or equal to 5000 z/ml, but mortality was low and an LC50 could not be calculated even after exposures to 50,000 z/ml. The 7-day, early life stage test with *P. promelas* produced reduced larva growth in most treatments. Several species (*Hydra* sp., *L. variegatus*, ostracoda, copepoda, *Physa* sp., and *P. promelas*) were not affected in acute tests at exposures of 50,000 z/ml. The data show, contrary to many reports, that *L. giganteum* may affect some nontarget aquatic species. The key to successful laboratory tests is monitoring and maintaining the zoospores' infection capacity.
Descriptors: *Lagenidium giganteum*, toxicity, invertebrates, *Pimephales promelas*, exposure, nontarget effects and organisms, aquatic environment, toxicology.

1993

Chui, V.W.; Koo, C.W.; Lo, W.M.; Xu-Jia, Q. (1993) **Laboratory evaluation of Vectobac SUP R -12AS and teflubenzuron against *Culex* and *Aedes* mosquito larvae under different physical conditions.** *Environment international.* 19(2): 193-202. ISSN: 0160-4120.
NAL Call Number: TD169.E54
Descriptors: control agents, treatment efficiency, laboratory study, larva, secondary effect, environment impact, freshwater environment, *Bacillus thuringiensis var. israelensis*, *Aedes aegypti*, *Aedes albopictus*, *Culex pipiens quinquefasciatus*, *Sida crystalline*, *Artemia salina*, Diptera, Cladocera, Branchiopoda, Crustacea, vector, ureas, microbial insecticide.

Suett, D.L.; Jukes, A.A.; Phelps, K. (1993) **Stability of accelerated degradation of soil-applied insecticides- laboratory behavior of aldicarb and carbofuran in relation to their efficacy against cabbage root fly (*Delia radicum*) in previously treated field soils.** *Crop Protection.* 12(6): 431-442. ISSN: 0261-2194.
NAL Call Number: SB599.C8
Descriptors: accelerated degradation, soil insecticides, aldicarb, carbofuran, cabbage root fly, insecticide efficacy, enhanced biodegradation, microorganisms.

1992

Hamer, M.J.; Maund, S.J.; Hill, I.R. (1992) **Laboratory methods for evaluating the impact of pesticides on water/sediment organisms.** *Brighton Crop Protection Conference: Pests and Diseases, Vols 1, 2 and 3.* (3): 487-496. ISBN: 0-948404-65-5. Notes: Brighton, England, November 23-26, 1992. ICI Agrochem., Jealotts Hill Res. Stn., Bracknell, Berkshire RG12 6EY, UK.
NAL Call Number: SB950 A2B74
Descriptors: freshwater ecology, pest assessment control and management, pollution assessment control and management, toxicology, Diptera, *Chironomus riparius*, benthic communities, environmental fate, toxicity, environmental biology, limnology, toxicology, environmental and industrial toxicology, public health: environmental health, air, water and soil, biochemical studies, comparative studies.

1989

Pontasch, K.W.; Cairns, J.Jr. (1989) **Establishing and maintaining laboratory-based microcosms of riffle insect communities: their potential for multispecies toxicity tests.** *Hydrobiologia.* 175(1): 49-60. ISSN: 0018-8158.
NAL Call Number: 410 H992
Descriptors: biological indicators, pollutants, flowing freshwater insect community, toxicity, developmental stage, Baetidae, Heptageniidae, Chironomidae, Ephemeroptera, Diptera, Virginia.

1978

McKague, A.B.; Pridmore, R.B.; Wood, P.M. (1978) **Effects of altosid and dimilin on black flies (Diptera: Simuliidae): laboratory and field tests.** *The Canadian entomologist.* 110(10): 1103-1110. ISSN: 0008-347X.
NAL Call Number: 421 C16
Descriptors: adult, contamination, Diptera, secondary effects, emergence, juvenile hormone analogue, insecticide, larva, chemical control, freshwater environment, mortality, *Simulium decorum*, *Simulium verecundum*, insect pests of humans and animals, biocontrol.

1974

Thornton, K.; Wilhm, J. (1974) **The effects of pH, phenol, and sodium chloride on survival and caloric, lipid, and nitrogen content of a laboratory population of *Chironomus attenuatus* (*walk.*).** *Hydrobiologia.* 45(2-3): 261-280. ISSN: 0018-8158.
NAL Call Number: 410 H992
Descriptors: *Chironomus*, chemical compound, waste water, energy metabolism, freshwater pollution, phenols, acidity, sodium chloride, midges.

1973

Cole, S.L.; Wilhm, J. (1973) **Effect of phenol on oxygen uptake rate of a laboratory population of *Chironomus Attenuatus* (*walk.*).** *Water research.* 7(11): 1691-1700. ISSN: 0043-1354.
NAL Call Number: TD420 W3
Descriptors: toxicity, freshwater environment, phenols, pollution, Diptera, midge.

Coleoptera

2004

Sibul, I.; Kuusik, A.; Voolma, K. (2004) **Monitoring of gas exchange cycles and ventilatory movements in the pine weevil *Hylobius abietis*: Respiratory failures evoked by a botanical insecticide.** *Entomologia Experimentalis et Applicata.* 110(2): 173-179. ISSN: 0013-8703.
NAL Call Number: 421 En895
Descriptors: pest assessment control and management, pesticides, Coleoptera, *Hylobius abietis,* large pine weevil, NeemAzal T/S, botanical insecticide, carbon dioxide, oxygen, electrolytic microrespirometer, apparatus stress, discontinuous gas exchange cycles, environmental stress, handling stress, muscular activity, respiratory failure, standard metabolic rate, ventilatory movements, comparative study.

1997

Cox, P.D.; Fleming, D.A.; Atkinson, J.E.; Bannon, K.L.; Whitfield, J.M. (1997) **The effect of behavior on the survival of *Cryptolestes ferrugineus* in an insecticide-treated laboratory environment.** *Journal of Stored Products Research.* 33(3): 257-269.
NAL Call Number: 421 J829
Descriptors: *Cryptolestes ferrugineus*, behavior, stored products pests, insecticides, malathion, fenitrothion, movement, Coleoptera, Cucujidae, insect pests, survival.

Gibson, P.H.; Cosens, D.; Buchanan, K. (1997) **A chance field observation and pilot laboratory studies of predation of the New Zealand flatworm by the larvae and adults of carabid and staphylinid beetles.** *Annals of applied biology.* 130(3): 581-585. ISSN: 0003-4746.
NAL Call Number: 442.8 AN72
Descriptors: predation, urban area, adult beetles, autochtonous, larvae, predator, Carabidae, *Lumbricus rubellus*, Staphylinidae, case and laboratory studies, field study, soil fauna, allotments, *Artioposthia trangulata*, *Vereinigtes koenigreich*, Umgebung, Coleoptera, Oligochaeta, Annelida, entomology, environment, zoology, garden, Turbellaria, Plathelmintha, Helmintha, beneficial species, carnivorous worms, noxious animal, invasive species, earthworm, Coleoptera, Scotland.

1996

Sustr, V.; Simek, M. (1996) **Behavioral responses to and lethal effects of elevated carbon dioxide concentration in soil invertebrates.** *European Journal Of Soil Biology.* 32(3): 149-155. ISSN: 1164-5563.
NAL Call Number: S590 R4
Descriptors: anesthesia, lethal doses, soil atmosphere, CO_2, Enchytraeids, earthworms, oxygen atmospheres, unselected strain, resistance, Hypercarbia, Coleoptera, mortality, hypoxia.

1992

Ebina, J.; Nakajima, S.; Adachi, M.; Yano, H. (1992) **Laboratory test on acute toxicity of agricultural chemicals to the early-stage larvae of *Luciola cruciata*.** *Kyoto Prefectural Institute of Hygienic and Environmental Sciences.* 37: 136-139. ISSN: 0389-5041.
Notes: Kyotofu Eisei Kogai Kenkyujo Nenpo (Annual Report of Kyoto Prefectural Institute of Hygienic and Environmental Sciences), Journal Number: Z0977AAA.
Descriptors: Lampyridae, larvae, habitat environment, pesticide, acute toxicity, lethal dose, sensitivity, Coleoptera, Pterygota, growth stage.

1984

Coulon, J. (1984) **Effet de la température sur l'efficacité de quelques insecticides. Étude de laboratoire sur l'activité de quelques substances appliquées au granarius sitophilus**

à 15, 20 et 25 degrés C. [Temperature effect on the efficiency of some insecticides. Laboratory study on the activity of some substances applied to Sitophilus granarius at 15, 20 and 25 Degree C.] *INRA, lab. phytopharmacie.* : 123-134. ISBN: 2-85340-601-6. Notes: Versailles 78000, France, In French.
Descriptors: cereal, stored product, Homoptera, insecticide, temperature, laboratory study, Curculionidae, pest, organophosphorus compounds, environmental factor, pyrethroids, *Sitophilus granaries*, *Triticum*.

1977

Brand, J.M.; Schultz, J.; Barras, S.J.; Edson, L.J.; Payne, T.L.; Hedden, R.L. (1977) **Bark-beetle pheromones: enhancement of *Dendroctonus frontalis* (Coleoptera: Scolytidae) aggregation pheromone by yeast metabolites in laboratory bioassays.** *Journal of Chemical Ecology.* 3(6): 657-666. ISSN: 0098-0331.
NAL Call Number: QD415.A1J6
Descriptors: attractants, acetic acid, turpentine, trees, agricultural entomology, *Hansenula holstii*, *Pichia pinus*, *Pichia bovis*, volatile metabolites, potentiating attractants for *Dendroctonus frontalis*, 1-butanol, 3-methyl-, benzeneethanol, 2-phenylethyl ester, acetate, 6,8-dioxabicyclo(3.2.1)octane, 1,5-dimethyl-, (1 alpha ,2 alpha ,5 alpha)-4,6,6-trimethylbicyclo(3.1.1)hept-3-en-2-ol, and turpentine, bicyclo(3.1.1)hept-3-en-2-ol, 4,6,6-trimethyl-, 1,5-dimethyl-6,8-dioxabicyclo(3.2.1)octane, and turpentine, 1,5-dimethyl-6,8-dioxabicyclo(3.2.1)octane, and (1 alpha ,2 alpha ,5 alpha)-4,6,6-trimethylbicyclo(3.1.1)hept-3-en-2-ol, CAS Registry Numbers: 64-19-7, yeasts, bark beetles, Scolytidae, Coleoptera, Eumycota, fungi, North America, repellents and attractants.

1975

Franek, M. (1975) **[Studies on the optimum conditions for laboratory cultures of the granary weevil - *Sitophilus granarius l.* (Col., Curculionidae) for testing insecticides. I. the influence of habitat factors on the development of insects.]** *Polskie Pismo Entomologiczne.* 45(1): 171-215. ISSN: 0032-3780. Note: In Polish.
NAL Call Number: 421 P76
Descriptors: insect development, mortality, environmental factors, techniques, stored products, agricultural entomology, *Sitophilus granaries*, Curculionidae, Coleoptera, chemical control, biodeterioration, storage problems and pests of food.

Collembola

1997

Trublaevich, Z.N.; Semenova, E.N. (1997) **[Estimation of soil toxicity using a laboratory culture of springtails (*Folsomia candida*).]** *Ekologiya (Moscow).* 5: 377-381. ISSN: 0367-0597. Notes: In Russian, Serial normally translated cover to cover in: Russian Journal of Ecology.

NAL Call Number: QH540.E3
Descriptors: *Folsomia candida*, Collembola, mortality, soil toxicity indicator value, laboratory study, lethal dose limit, chemical pollution and factors, ecology, population dynamics, abiotic factors.

1996

Sandifer, R.D.; Hopkin, S.P. (1996) **Effects on pH on the toxicity of cadmium, copper, lead and zinc to *Folsomia candida willem, 1902* (Collembola) in a standard laboratory test system.** *Chemosphere.* 33(12): 2475-2486. ISSN: 0045-6535.
NAL Call Number: TD172.C54
Descriptors: pollution assessment control and management, soil science, toxicology, Collembola, springtail, *Folsomia candida*, cadmium, copper, lead, zinc, acidity, heavy metals, toxicology, environmental biology, physiology and pathology, biochemical studies, biophysics, molecular properties and macromolecules.

Homoptera

1994

Bloch, G.; D. Wool (1994) **Methidathion resistance in the sweetpotato whitefly (Aleyrodidae: Homoptera) in Israel: selection, heritability, and correlated changes of esterase activity.** *Journal of economic entomology.* 87(5): 1147-1156. ISSN: 0022-0493.
NAL Call Number: 421 J822
Abstract: Artificial selection for increased resistance to methidathion in two replicate lines of the whitefly, *Bemisia tabaci* (*gennadius*) (originating from a cotton-field-collected greenhouse population) was successful; LC50s increased 7-8.6-fold in eight generations in the selected lines. This indicates the existence of additive genetic variance for resistance in the source population. Minimal realized heritability estimates, calculated from the response to selection, were h2 = 0.49 after one generation (with minimal effects of common laboratory environment and inbreeding) and a mean value of h2 = 0.344 after eight generations. Esterase activity (measured from the hydrolysis of beta-naphthyl butyrate) increased in the selected lines in correlation with resistance. We observed no change in mean esterase activity in the unselected (control) population. No consistent differences in fitness components between selected and control lines were detected during selection, but females exposed to sublethal doses of methidathion tended to have increased fecundity.
Descriptors: *Bemisia tabaci*, methidathion, insecticide resistance, heritability, artificial selection, genetic variance, esterases, enzyme activity, fecundity, Israel.

1993

Omer, A.D.; B.E. Tabashnik; M.W. Johnson; H.S. Costa; D.E. Ullman (1993) **Genetic and environmental influences on susceptibility to acephate in sweetpotato whitefly**

(Homoptera: Aleyrodidae). *Journal of economic entomology.* 86(3): 652-659. ISSN: 0022-0493.
NAL Call Number: 421 J822
Abstract: The effects of genotype, host plant, and age on susceptibility to acephate in the B biotype of sweetpotato whitefly, *Bemisia tabaci* (*gennadius*) were examined. Offspring of adults collected from a frequently treated site and an infrequently treated site in Hawaii were reared in the laboratory on pole bean, *Phaseolus vulgaris l.*; tomato, *Lycopersicon esculentum mill.*; and zucchini, *Cucurbita pepo l.* Seven- and 14-d-old adult offspring from each host plant were tested for susceptibility to acephate in 12 laboratory bioassays (2 colonies X 3 hosts X 2 ages). Twenty-fold differences in LC50 between colonies with environmental conditions held constant indicated a genetically based resistance to acephate. Host plant had no significant effect on susceptibility to acephate. The LC50 of 7-d-old adults was consistently double the LC50 of 14-d-old adults. Although the 95% confidence limits of LC50 overlapped in pairwise comparisons between age classes, ANOVA showed that the effect of age was highly significant. Results suggest that differences in LC50 that are greater than or equal to-10-fold are likely to be based partly, if not entirely, on genetic differences. Much additional work is needed to determine if the results are broadly applicable. We encourage use of ANOVA in future studies because it provides simple and direct tests for overall effects of genotype, environment, and genotype X environment interaction.
Descriptors: B biotype *Bemisia tabaci*, genotype environment interaction, hosts of plant pests, LC50, bean, tomato, zucchini, insecticide resistance, susceptibility, acephate.

1984

Moreno, D.S.; Fargerlund, J.; Ewart, W.H. (1984) **Citrus mealybug (Homoptera: Pseudococcidae): behavior of males in response to sex pheromone in laboratory and field.** *Annals of the Entomological Society of America.* 77(1): 32-38. ISSN: 0013-8746.
NAL Call Number: 420 En82
Descriptors: Homoptera, sexual behavior, male response to sex pheromone, light, Pseudococcidae, environmental factor, *Planococcus citri*, *Micrococcales*, bacteria.

Hymenoptera

2004

Nazzi, F.; Della, V.G.; D'Agaro, M. (2004) **A semiochemical from brood cells infested by Varroa destructor triggers hygienic behaviour in Apis mellifera.** *Apidologie.* 35(1): 65-70. ISSN: 0044-8435.
NAL Call Number: SF521.A64
Descriptors: behavior, biochemistry and molecular biophysics, communication, terrestrial ecology, Acarina, Chelicerata, Hymenoptera, *Varroa destructor*, parasite, *Apis mellifera*, honey bee, brood cells, chemicals and biochemicals, semiochemical, volatile hydrocarbons, SPME gas chromatography, mass spectrometry, chromatographic techniques, laboratory techniques, spectrum analysis techniques, bioassay, laboratory

techniques, behavioral triggers, chemical signaling, olfactory cues, behavioral biology, comparative study, environmental biology.

Rudeschko, O.; Maclinik, A.; Doerfelt, H.; Kaatz, H.H.; Schlott, B.; Kinne, R.W. (2004) **A novel inhalation allergen present in the working environment of beekeepers.** *Allergy.* 59(3): 332-337. ISSN: 0105-4538.
NAL Call Number: RC583.A5
Descriptors: allergy, clinical immunology, human medicine, medical sciences, occupational health, Acarina, Hymenoptera, Varroa mite, inhalation allergen source, beekeeper working environment, ELISA, laboratory techniques, SDS polyacrylamide gel electrophoresis, electrophoretic techniques, amino acid sequencing, genetic techniques, immunoblot, isoelectric focusing.

2000

Tasei, J.N.; Lerin, J.; Ripault, G. (2000) **Sub-lethal effects of imidacloprid on bumblebees, *Bombus terrestris* (Hymenoptera: Apidae), during a laboratory feeding test.** *Pest management science.* 56(9): 784-788. ISSN: 1526-498X.
NAL Call Number: SB951 P47
Descriptors: agricultural chemical product, non target effect, environment impact, dose activity relation, sublethal dose, ecotoxicology, brood, survival, reproductive potential, *Bombus terrestris*, wild bees, pollinator, *Helianthus annuus*, colony, chemical contamination, laboratory study, nectar, pollen, Hymenoptera, toxicity, oil plant, vegetal, guanidines, insecticide, pesticides, systemic, nitroguanidine derivatives.

1997

Fresquez, P.R.; Armstrong, D.R.; Pratt, L.H. (1997) **Radionuclides in bees and honey within and around Los Alamos National Laboratory.** *Journal of Environmental Science and Health Part A Environmental Science and Engineering and Toxic and Hazardous Substance Control.* 32 (5): 1309-1323. ISSN: 1077-1204.
NAL Call Number: TD172.J6
Descriptors: physiology, radiation biology, toxicology, honeybee, honey composition, Hymenoptera, New Mexico.

1996

Hebling, M.J.; Maroti, P.S.; Bueno, O.C.; Silva, O.A.; Pagnocca, F.C. (1996) **Toxic effects of leaves of *Ricinus communis* (Euphorbiaceae) to laboratory nests of *Atta sexdens rubropilosa* (Hymenoptera: Formicidae).** *Bulletin of Entomological Research.* 86(3): 253-256. ISSN: 0007-4853.
NAL Call Number: 421 B87
Descriptors: toxic effects, Hymenoptera, Myrtaceae, *Atta sexdens rubropilosa*, *Eucalyptus alba*, Formicidae, *Ricinus communis*, ant mortality rate, diet item, fungal garden growth, oxygen consumption rate, necrosis, energy and respiratory metabolism, toxicology, biochemistry and biophysics, comparative study.

1994

Helson, B.V.; Barber, K.N.; Kingsbury, P.D. (1994) **Laboratory toxicology of six forestry insecticides to four species of bee (Hymenoptera: Apoidea).** *Archives of Environmental Contamination and Toxicology.* 27(1): 107-114. ISSN: 0090-4341.
NAL Call Number: TD172 A7
Descriptors: cell biology, ecology, genetics, methods and techniques, pathology, forest pest assessment control and management, pollution assessment control and management, toxicology, Hymenoptera, *Andrena erythronii*, *Apis mellifera*, *Bombus terricola*, *Megachile rotundata*, permethrin, mexacarbate, aminocarb, fenitrothion, carbaryl, trichlorfon, environmental toxicology, median lethal dose, mexacarbate, permethrin, trichlorfon, cytology and cytochemistry, genetics and cytogenetics, environmental health-air, water and soil pollution, effects of pesticides, herbicides.

1993

Belzunces, L.P.; Colin, M.E. (1993) **Le synergisme entre les insecticides et les fongicides s'est appliqué aux doses sous-léthales dans les abeilles. Une approche expérimentale de laboratoire. [Synergism between insecticides and fungicides applied at sublethal doses in bees. An experimental laboratory approach.]** *Phytoma.* (446): 20-22/ 24. ISSN: 1164-6993. Note: In French.
NAL Call Number: 464.8 P563
Descriptors: pollinators, fatty oil plants, rape, nontarget effects, insecticides, fungicides, carbendazim, prochloraz, synergism, toxicity, pesticides, environmental impact, pollination, pesticide synergists, agricultural entomology, plant pathology, difenoconazol, decamethrin, CAS registry numbers: 10605-21-7 and 67747-09-5, Hymenoptera, Apidae, *Apis mellifera*, *Brassica napus var. oleifera*, beneficial organisms, oil plants, Spermatophyta, benzimidazole fungicides, conazole fungicides, *Capparidales*, dicotyledons, angiosperms, control by chemicals and drugs, bee toxicology, poisoning and pharmacology, pollution and degradation.

Isoptera

1997

Su, N.Y.; Chew, V.; Wheeler, G.S.; Scheffrahn, R.H. (1997) **Comparison of tunneling responses into insecticide-treated soil by field populations and laboratory groups of subterranean termites (Isoptera: Rhinotermitidae).** *Journal of Economic Entomology.* 90(2): 503-509. ISSN: 0022-0493.
NAL Call Number: 421 J822
Descriptors: *Coptotermes formosanus*, *Reticulitermes flavipes*, termiticides, tunneling response, laboratory bioassay, field bioassay, urban environment, termite penetration, chemical barrier.

1991

Su, N.Y.; Scheffrahn, R.H. (1991) **Laboratory evaluation of 2 slow-acting toxicants against formosan and eastern subterranean termites (Isoptera, Rhinotermitidae).** *Journal of Economic Entomology.* 84(1): 170-175. ISSN: 0022-0493.
NAL Call Number: 421 J822
Descriptors: subterranean termites, bioassays, bait-toxicants, urban-environment, remedial control, *Reticulitermes*, insecticides, populations, toxicity.

Lepidoptera

1995

Gopalakrishnan, B.; S. Muthukrishnan; K.J. Kramer (1995) **Baculovirus-mediated expression of a *Manduca sexta* chitinase gene: properties of the recombinant protein.** *Insect biochemistry and molecular biology.* 25(2): 255-265. ISSN: 0965-1748.
NAL Call Number: QL495.A1I57
Abstract: We constructed a recombinant nonoccluded baculovirus, *Autographa californica* nuclear polyhedrosis virus (AcMNPV), containing a 1.8 kb DNA fragment from a *Manduca sexta* (tobacco hornworm) chitinase cDNA under the control of the polyhedrin gene promoter. When *Spodoptera frugiperda* (fall armyworm) cells (SF9) were infected with this recombinant virus, a protein with an apparent molecular weight of 85 kDa was secreted into the culture medium. This protein hydrolyzed chitin and cross-reacted with a polyclonal antibody to *M. sexta* molting fluid chitinase. Tunicamycin treatment of infected SF9 cells and subsequent western blot analysis indicated that the secreted enzyme was a glycoprotein. GC-MS analysis revealed that carbohydrate accounted for approximately 25% of the mass of glycoprotein. The recombinant chitinase and the molting fluid enzyme were indistinguishable by N-terminal sequencing, polyacrylamide gel electrophoresis and carbohydrate analysis, indicating that the recombinant protein was similar, if not identical, to the molting fluid enzyme. Analysis of the expression level of recombinant chitinase in SF9, SF21 and *Trichoplusia ni* (Hi-5) cell lines showed that the yields were in the order Hi-5 > SF21 > SF9. Chitinase accumulated in hemolymph after injection of fourth instar *M. sexta* and *S. frugiperda* larvae with recombinant virus. The median time for mortality of *S. frugiperda* fourth instar larvae infected with the recombinant virus was approximately 20 h shorter than that for insects infected with a wild type virus. The results support the hypothesis that insect chitinase has potential to enhance the insecticidal activity of entomopathogens.
Descriptors: *Manduca sexta*, tobacco hornworm, nuclear polyhedrosis viruses, viral insecticides, chitinase, complementary DNA, recombinant DNA, promoters, viral proteins, gene expression, enzyme activity, chitin, hydrolysis, insecticidal properties, *Spodoptera frugiperda*, fall armyworm.

Sauphanor, B.; J.C. Bouvier (1995) **Cross-resistance between benzoylureas and benzoylhydrazines in the codling moth, *Cydia pomonella l.*** *Pesticide science.* 45(4): 369-375. ISSN: 0031-613X.

NAL Call Number: SB951.P47
Abstract: Failure in the control of the codling moth, *Cydia pomonella l.*, with diflubenzuron was observed for three years in several locations of southern France. A laboratory procedure was set up to screen field populations for resistance to insecticides which regulate or inhibit insect development. Last-instar larvae were captured with corrugated cardboard traps, and the tests were conducted on the F1 progeny. Newly hatched larvae were deposited in individual cups on thin layers of artificial diet, first treated with the pesticide by the way of a spray tower. They were then placed in a controlled environment chamber at 25 (+/-1) degrees C. Mortality was recorded after the first moulting, i.e. five days after infestation. These tests revealed a 370-fold resistance to diflubenzuron in one population of *C. pomonella*. Cross-resistance was observed with the two other benzoylureas registered in France against this species: teflubenzuron (seven-fold resistance) and triflumuron (102-fold resistance). The two populations observed also presented cross-resistance (26-fold) with the ecdysone analogue tebufenozide (benzoylhydrazine), to which they had not previously been exposed. This is the first record of naturally occurring resistance to this new compound. Ovicidal tests on F3 progeny also indicated possible cross-resistance with the juvenile hormone analogue, fenoxycarb, for one strain. The resistance to these different insecticides appears to be codominant. It also proved possible to detect resistance by testing the F1 progeny of males captured with non-adhesive sex pheromone traps, paired with females of a laboratory susceptible strain.
Descriptors: *Cydia pomonella*, strains, populations, insecticide resistance, diflubenzuron, teflubenzuron, triflumuron, fenoxycarb, insect growth regulators, azinphos methyl, cross resistance.

1993

Chandler, L.D (1993) **Use of feeding stimulants to enhance insect growth regulator-induced mortality of fall armyworm (Lepidoptera: Noctuidae) larvae.** *Florida entomologist.* 76(2): 316-326. ISSN: 0015-4040.
NAL Call Number: 420 F662
Descriptors: *Vigna unguiculata*, *Spodoptera frugiperda*, larvae, mortality, diflubenzuron, biocontrol, insect growth regulators, phagostimulants.

1992

Tabashnik, B.E. (1992) **Resistance risk assessment: realized heritability of resistance to *Bacillus thuringiensis* in diamondback moth (Lepidoptera: Plutellida), tobacco budworm (Lepidoptera: Noctuidae), and Colorado Potato beetle (Coleoptera: Chrysomelidae).** *Journal of economic entomology.* 85(5): 1551-1559. ISSN: 0022-0493.
NAL Call Number: 421 J822
Abstract: A new method for estimating realized heritability (h2) of resistance to insecticides from laboratory selection experiments is described. A major advantage of this method for estimating h2, the proportion of total phenotypic variation attributable to additive genetic variation, is that it requires only data that are collected routinely in selection studies (i.e., LC50 and slope before and after selection, and average mortality

caused by selection each generation). Estimates of h2 of resistance calculated with this method were virtually identical to two previously reported estimates calculated by a regression method that requires estimates of LC50 for every generation. Estimates of h2 of resistance to *Bacillus thuringiensis* in *Plutella xylostella* (*l.*) were 0.14, 0.17, and 0.18 in three strains initiated from a moderately resistant field population in Hawaii compared with 0.047 in a laboratory strain from France. Estimated h2 of resistance to *B. thuringiensis* was 0.17 in *Helicoverpa virescens* (*f.*) and 0.09 in *Leptinotarsa decemlineata* (*say*). Extrapolation to field populations is problematic. However, assuming that these h2 estimates can be extrapolated to the field and that populations receive prolonged and uniform exposure to *B. thuringiensis* causing greater than 90% mortality each generation, substantially increased resistance would be expected after less than 10 generations for *H. virescens* and less than 15 generations for *L. decemlineata*. In six cases examined here, h2 was higher in the first half of selection experiments (mean = 0.38) than in the second half (mean = 0.15). This suggests that brief selection experiments (4-6 generations) may most efficiently detect the potential for resistance development. Estimation of h2 of resistance based on the method described here provides a means for systematic, quantitative analysis of selection experiments, including many of the greater than 150 previously reported studies. This approach can improve evaluation of results from selection experiments and may enhance their integration into systems of resistance risk assessment.
Descriptors: *Leptinotarsa decemlineata*, *Plutella xylostella*, heritability, insecticide resistance, mortality, susceptibility, *Bacillus thuringiensis*, bacterial insecticides.

1990

Rose, R.L.; Leonard, B.R.; Sparks, T.C.; Graves, J.B. (1990) **Enhanced metabolism and knockdown resistance in a field versus a laboratory strain of the soybean looper (Lepidoptera: Noctuidae).** *Journal of Economic Entomology.* 83(3): 672-677. ISSN: 0022-0493.
NAL Call Number: 421 J822
Descriptors: pests, enzymes, metabolism, soyabeans, insecticides, resistance, Permethrin, legumes, agricultural entomology, CAS Registry Numbers: 52645-53-1, Lepidoptera, Noctuidae, *Chrysodeixis includens*, pesticide and drug resistance, Louisiana.

1976

Pimaud, M.F.; Cangardel, H.; Fleurat-Lessard, F. (1976) **Effets des doses fortes de Zeta dans un environnement confiné sur la reproduction de l'interpunctella Hubner (Lepidoptera Pyralidae) de Plodia dans le laboratoire. [Effects of strong doses of Zeta in a confined environment on the reproduction of Plodia interpunctella Hubner (Lepidoptera Pyralidae) in the laboratory.]** *Sex pheromones of the Lepidoptera.: Les pheromones sexuelles des Lepidopteres* : 129-135. Notes: Institut National de Recherches Agronomiques, Centre de Recherches de Bordeaux. Pont-de-la-Maye, France, In French.
Descriptors: mating disruption, biocontrol, behavior, stored products, agricultural entomology, 9,12-tetradecadien-1-ol; acetate, *Plodia interpunctella*, Pyralidae,

Lepidoptera, repellents and attractants, pathogen, pest and parasite management, pathogens and biogenic diseases, biodeterioration.

Orthoptera

1997

Kaakeh, W.; B.L. Reid; N. Kaakeh; G.W. Bennett (1997) **Rate determination, indirect toxicity, contact activity, and residual persistence of lufenuron for the control of the German cockroach (Dictyoptera: Blattellidae).** *Journal of economic entomology.* 90(2): 510-522. ISSN: 0022-0493.
NAL Call Number: 421 J822
Abstract: Three interrelated laboratory and greenhouse studies were conducted for the chitin synthesis inhibitor lufenuron to determine dose-activity, indirect toxicity, contact activity, and residual persistence against the German cockroach, *Blatella germanica* (*l.*). Lufenuron activity was determined by evaluating 3 response variables (percentage of molt inhibition, percentage of affected adults, overall percentage of mortality). These variables were unified in a dose-response rating score (the mean effects rating). In the rate determination study, differences in lufenuron activity on different surfaces (clean masonite, oily-frass masonite, unpainted plywood) had more effect on the results than did the application rate (10, 25, 50 mg/m2), life stage (3rd or 5th instars), and exposure time (15, 30, 60 min). Percentage of molt inhibition and the effects ratings were significantly greater at 25 and 50 mg/m2 than at 10 mg/m2. No differences its percentage of affected 4th instars or adults were found between 3rd and 5th instars, however, higher effects on 5th instars were observed for percentage of molt inhibition, overall percentage of mortality, arid effects rating. There was a significant effect on oothecal production from females exposed to lufenuron deposit during oogenesis. The number of viable oothecae decreased, the number of aborted oothecae increased, nymphal hatch decreased, nymphal survival at 7 d after hatch decreased, and nymphal survival of the 1st molt decreased with an increase in the rate at each exposure time. In indirect toxicity tests, lufenuron activity significantly decreased with a decrease in the ratio of exposed to unexposed cockroaches. Exposure time had no effect on the indirect toxicity of lufenuron among cockroaches. Its residual persistence tests, surface had more influence on the results than the environment, rate, or residual aging period. Lufenuron was most active on masonite, with deposits on plywood being more active than on oily-frass masonite. Residues aged in the laboratory were significantly more active than those aged in the greenhouse for most response variables and effects rating. A rate of 25 mg/m2 was significantly different from 10 mg/m2 for most response variables and effects rating. Effects rating reduced significantly at 6 and 12 mo of aging. Surfaces produced significant effects in all response variables until 9 mo of aging. After 12 mo, lufenuron activity on plywood and oily-frass masonite declined significantly compared with the activity on Masonite.
Descriptors: *Blattella germanica*, chitin synthesis inhibitors, benzoylphenylureas, toxicity, application rates, residual effects, persistence, insecticide residues, mortality, molting, inhibition, reproduction, surfaces, efficacy, biocontrol.

1985

Hinks, C.F. (1985) **The influence of temperature on the efficacy of three pyrethroid insecticides against the grasshopper, *Melanoplus sanguinipes* (*fab.*) (Orthoptera: Acrididae), under laboratory conditions.** *Canadian entomologist.* 117(8): 1007-1012. ISSN: 0008-347X.
NAL Call Number: 421 C16
Descriptors: Orthoptera, cereal crop, insecticide, therapeutic efficiency, temperature, laboratory study, toxicity, pest, chemical control, pyrethroids, environmental factor, *Melanoplus sanguinipes*, Acrididae.

Miscellaneous

2004

Gosselin, A.; Hare, L. (2004) **Effect of sedimentary cadmium on the behavior of a burrowing mayfly (Ephemeroptera, Hexagenia limbata).** *Environmental Toxicology and Chemistry.* 23(2): 383-387. ISSN: 0730-7268.
NAL Call Number: QH545.A1E58
Descriptors: behavior, freshwater ecology, toxicology, Ephemeroptera, *Hexagenia limbata*, burrowing mayfly, nymph, burrowing activity, cadmium, sediment pollutant, infrared video camera, environmental biology.

1999

Pastershank, G.M.; Muir, D.C.; Fairchild, W.L. (1999) **Accumulation and depuration of 2,3,7,8-tetrachlorodibenzofuran and octachlorodibenzo-p-dioxin by caddisfly larvae (*Hydropsyche bidens* (*ross*)) in miniature laboratory streams.** *Environmental toxicology and chemistry.* 18(10): 2352-2360. ISSN: 0730-7268.
NAL Call Number: QH545.A1E58
Descriptors: biological accumulation, filter feeder insects, larva, absorption, elimination, laboratory study, stream, artificial medium, freshwater environment, Hydropsychidae, Trichoptera.

1998

Herman, R.A. (1998) **Whole-insect laboratory bioassays in insecticide research.** *Reviews in Toxicology (Netherlands).* 2(7-8): 445-475. ISSN: 1382-6980. Note: CODEN: RETOF.
NAL Call Number: QH545.A1R484
Descriptors: insecticide, bioassay, chemical interaction, environmental factor, automation, quantitative structure activity relation, clinical and experimental biochemistry, toxicology.

1996

Schmuck, R.; Mager, H.; Kuenast, C.; Bock, K.D.; Storck-Weyhermueller, S. (1996) **Variability in the reproductive performance of beneficial insects in standard laboratory toxicity assays: Implications for hazard classification of pesticides.** *Annals of applied biology.* 128(3): 437-451. ISSN: 0003-4746.
NAL Call Number: 442.8 AN72
Descriptors: data analysis, performance analysis, risk analysis, classification, assay, ecotoxicology, non-target effect, laboratory test, variability, beneficial insects, pesticides, method study, biomathematics, entomology, pest management, phytopharmacology, European Union.

1995

Camargo, J.A. (1995) **Effect of body size on the intraspecific tolerance of aquatic insects to low pH: A laboratory study.** *Bulletin of Environmental Contamination and Toxicology.* 54(3): 403-408. ISSN: 0007-4861.
NAL Call Number: RA1270.P35A1
Descriptors: freshwater ecology, metabolism, physiology, wildlife management, Trichoptera, *Cheumatopsyche pettiti*, *Lepidostoma liba*, sodium, ecosystem, ion regulation, limnology, environmental biology, comparative and experimental morphology, pathology, biochemical studies, minerals.

Tochimoto, H.; Nishima, T. (1995) **[Study of aquatic insect, caddisfly, *Stenopsyche marmorata* as bio-monitor of trace element contamination in rivers and streams: accumulation of waterborne trace elements under laboratory conditions.]** *Journal of Japan Society on Water Environment.* 18(11): 917-923. ISSN: 0916-8958. Note: In Japanese.
Descriptors: river pollution, indicator organism, Trichoptera, trace element, biological concentration, bioaccumulation, exposure test, heavy metal, cadmium, mercury, water quality test, water pollution, environmental quality index, Pterygota, minor component, concentration, enrichment, separation, storage and accumulation, environmental test, 2B group element, transition metal, water quality survey, investigation, analysis, separation.

1992

Kreutzweiser, D.P.; Holmes, S.B.; Capell, S.S.; Eichenberg, D.C. (1992) **Lethal and sublethal effects of *Bacillus thuringiensis var. kurstaki* on aquatic insects in laboratory bioassays and outdoor stream channels.** *Bulletin of environmental contamination and toxicology.* 49(2): 252-258. ISSN: 0007-4861.
NAL Call Number: RA1270.P35A1
Descriptors: toxicity of microbial insecticide, non-target organisms, mortality, *Bacillus thuringiensis var. kurstaki*, *Bacillus thuringiensis var. israelensis*, freshwater environment, Plecoptera.

1991

Fischer, R.; Heimbach, F. (1991) **Pesticides and natural balance - examination, hazard assessment and risk evaluation. Part IV: Possibilities and limits of the use of laboratory data.** *Gesunde Pflanzen.* 43(8): 270-274. ISSN: 0367-4223.
NAL Call Number: 464.8 G33
Descriptors: insecticides, pesticides, nontarget effects, techniques, assessment, environment, pollution and degradation, techniques, pest control by chemicals.

1989

Leeuwangh, P. (1989) **[Analysis of the risk from pesticides by ecotoxicological research in the laboratory and in test ditches.]** *Gewasbescherming.* 20(2): 51-61. ISSN: 0166-6495. Note: In Dutch.
NAL Call Number: SB599.G4
Descriptors: aquatic organisms, nontarget effects, pollution, insecticides, pesticides degradation, canals, ditches, residues, aquatic communities, chlorpyrifos effects, pesticide residues, CAS Registry Numbers: 2921-88-2, Crustacea, fishes, algae, *Gasterosteus aculeatus*, organothiophosphate insecticides, organophosphorus, *Gasterosteiformes*, *Osteichthyes*, Netherlands.

1987

Clements, W.H.; Cherry, D.S.; Cairns, J., Jr. (1987) **Structural alterations in aquatic insect communities exposed to copper in laboratory streams.** *Environmental Toxicology and Chemistry.* 7(9): 715-722. ISSN: 0730-7268.
NAL Call Number: QH545.A1E58
Descriptors: copper, metals, stream water pollution, aquatic insects community, environmental impact, CAS Registry Numbers: 7440-50-8, Ephemeroptera, Diptera, Plecoptera, Simuliidae, *Prosimulium*, Chironomidae, degradation, freshwater and brackish water, Virginia.

Poirier, D.G.; Surgeoner, G.A. (1987) **Laboratory flow-through bioassays of four forestry insecticides against stream invertebrates.** *Canadian Entomologist.* 119(9): 755-763. ISSN: 0008-347X.
NAL Call Number: 421 C16
Descriptors: *Orconectes propinquus*, Astacura, Pycnopsyche, Diptera, *Simulium venustum*, *Isonychia*, Ephemeroptera, *Ophiogomphus*, Odonata, *Phasganophora*, Plecoptera, measurement of environmental factors, mortality, environmental simulation for insecticide toxicity evaluation, chemical pollution, organic, insecticide toxicity, stream environment simulation test, ecological techniques, population dynamics, habitat, lotic water, Reptantia, Decapoda, Eucarida, Eumalacostraca, Malacostraca, Crustacea, Nematocera, true flies.

1984

Bauer, M.; Patnode, R. (1984) *Health Hazard Evaluation Report HETA 81-121-1421, Insect Rearing Facilities.* Agricultural Research Service, United States Department of Agriculture. National Inst. for Occupational Safety and Health, Cincinnati, OH. Notes: Corporate Source Codes: 052678000, Report Number: HETA-81-121-1421, 44 pgs., Journal Announcement: GRAI8514.
Abstract: In December 1980 the Agricultural Research Service (ARS) requested technical assistance in evaluation of the prevalence and causes of occupational allergies at its ninety-eight facilities devoted to raising colonies of insects for entomological research. Visits by NIOSH investigators were made to six insect rearing facilities in order to develop a better understanding of the nature of this type of work. A nationwide survey of employees was conducted using mailed self-administered questionnaires. On the basis of this evaluation, NIOSH has determined that the majority of insect rearing facilities have at least one employee who has experienced symptoms consistent with occupational allergy related to exposures inherent to working with insects. Five facilities have ten or more employees experiencing such symptoms. Recommendations for reducing exposures to allergenic particulates in arthropod research facilities and for medical surveillance of the workers are contained in this report.
Descriptors: environmental surveys, industrial medicine, allergic diseases, laboratories, entomology, exposure, toxicity, inspection, hazardous materials, insect control, toxic substances, occupational safety and health, SIC 8922, NTISHEWOSH.

1981

Mohsen, Z.H.; Mulla, M.S. (1981) **Toxicity of blackfly larvicidal formulations to some aquatic insects in the laboratory.** *Bulletin of Environmental Contamination and Toxicology.* 26 (5): 696-703. ISSN: 0007-4861.
NAL Call Number: RA1270.P35A1
Descriptors: selective blackfly larvicides, nontarget organisms, insecticides, formulations, *Simulium* larvae, laboratory conditions, environmental impact, pesticides, toxicity, chemical engineering.

1979

Kotila, P.M. (1979) **Effect of antimycin of stream insects in field and laboratory trials.** *Dissertation abstracts international. B: The Sciences and engineering.* 40(3): 1051. ISSN: 0419-4217.
NAL Call Number: Z5055 U49D53
Descriptors: antibiotics, Coleoptera, Diptera, population dynamics, secondary effect, emergence, Ephemeroptera, laboratory study, freshwater environment, toxicity, Plecoptera, Trichoptera.

1978

Ali, S. (1978) **Degradation and environmental fate of endosulfan sulfate in mouse, insect and laboratory model ecosystem.** *Dissertation abstracts international. B: The Sciences and engineering.* 39(5): 2117. ISSN: 0419-4217.
NAL Call Number: Z5055 U49D53
Descriptors: Lepidoptera, catabolism, endosulfan sulphate breakdown and tissue storage, chemical pollution, larvae, salt marsh species, metabolic biochemistry.

1977

Van Belle, G.; L. Fisher (1977) **Monitoring the environment for ecological change.** *Research journal of the Water Pollution Control Federation.* 49(7): 1671-1679. Note: Refs.
NAL Call Number: 293.8 SE8
Descriptors: water systems.

World Wide Web Resources

Drosophila

Berkeley Drosophila Genome Project
http://www.fruitfly.org/
- This is listed on the About BDGP page, "The Berkeley Drosophila Genome Project (BDGP) is a consortium of the Drosophila Genome Center, funded by the National Human Genome Research Institute, National Cancer Institute, and Howard Hughes Medical Institute, through its support of work in the Gerald Rubin and Allan Spradling laboratories." See the site for additional information about this excellent resource.

Drosophila Virtual Library
http://ceolas.org/VL/fly/
- There is a link to this page from the **Drosophila Research Conference- 2004** at: http://www.drosophila-conf.org/
- Also, here's the site description as listed, "This directory points to internet resources for research on the fruit fly Drosophila melanogaster."

FlyBase
http://flybase.bio.indiana.edu/
- Here's another resource listed at the 2004 Drosophlia Research Conference site. This is listed on their information page, "FlyBase is a database of genetic and molecular data for Drosophila. FlyBase includes data on all species from the family Drosophilidae; the primary species represented is Drosophila melanogaster. FlyBase is produced by a consortium of researchers funded by the National Institutes of Health, U.S.A., and the Medical Research Council, London. This consortium includes both Drosophila biologists and computer scientists at Harvard University, University of Cambridge (UK), Indiana University, University of California, Berkeley, and the European Bioinformatics Institute. A complete list of consortium members is available in Reference Manual I.4. The FlyBase Consortium."

Flybrain: An Online Atlas and Database of the Drosophila Nervous System
http://flybrain.neurobio.arizona.edu/
- Developed at the University of Freiburg, the site contains an atlas of the *Drosophila* brain using a hypertext tour to the basic structural elements of the nervous system. It links schematic representations and serial sections through the brain, Golgi impregnations of individual cells, enhancer-trap images, and other gene expression data. Included are JAVA applets and VRML manipulatable reconstructions. Additional information covers staining for neuractive substances and comparisons of *Diptera* with *Drosophila*.
- This additional site, **Images of the Drosophila Nervous System**, is being integrated into Flybrain and is still available at:
  http://brain.biologie.uni-freiburg.de/Atlas/text/index.html
  It is a database of Drosophila neurobiology.

FlyView: A Drosophila Image Database
http://flyview.uni-muenster.de/Home.html
- From the site, "FlyView is the beginning of an image database on Drosophila development and genetics, especially on expression patterns of genes (enhancer trap lines, cloned genes).The

concept of FlyView includes compatibility to FlyBase, the main Drosophila database. Our aim is to establish the possibility to compare images on the computer screen and to search for special patterns at different developmental stages."

The Fruit Fly in You
http://science.nasa.gov/headlines/y2004/03feb_fruitfly.htm?list915922
- Although this is an example of the endless possibilities of the Drosophila model, it also serves as a valuable tool for handling/ rearing information such as this link contained: Drosophila Drosophila Behavior and Gene Behavior and Gene Expression in Expression in Microgravity Microgravity (http://science.nasa.gov/headlines/y2004/images/fruitfly/Beckingham.OBPR.12-03.pdf_1.pdf)

Homophila
http://homophila.sdsc.edu/
- This is a rather interesting database which claims, "The purpose of the Homophila database is to utilize the sequence information of human disease genes from the Online Mendelian Inheritance in Man (OMIM) database in order to determine if sequence homologs of these genes exist in the current Drosophila sequence database (FlyBase)." It is an NIH-supported joint venture between the Univ. of CA- San Diego and the Baylor College of Medicine.

The Interactive Fly
http://sdb.bio.purdue.edu/fly/aimain/1aahome.htm
- The author of this site, Dr. Thomas Brody, was awarded a 2002 SciTech Award for his achievements in producing this resource. Beyond exploring this cyberspace guide to Drosophila development, you can find out about bazooka, eyeless, lame duck, shaggy and all the rest: this guide to the myriad fruit fly (Drosophila) genes and their control functions is a monumental magnum opus that has become a standard in the field of developmental biology. Special thanks again to Dr. Brody for his permission using the Drosophila images on the cover page of this publication.

Jfly
http://jfly.iam.u-tokyo.ac.jp/
- This Japanese site describes itself, "Jfly is a data depository for Drosophila researchers. Information on the fruit fly (Drosophila melanogaster) and other insects are collected. The emphasis is placed on collecting information and documents for Japanese-speaking fly community." Included are: images, movies, manuals and protocols, newsletter, products information, and more. Most of this site is available in English.

Other Diptera

The Chironomid Home Page
http://www.sci.ouc.bc.ca/fwsc/iwalker/intpanis/
- This site is geared towards researchers interested in chironomids (midges). It contains newsletters, extensive bibliographies, discussion groups, a directory of chironomid workers, and links to related pages, as well as aquatic biology and other insects.

Diptera Site- Systematic Entomology Laboratory
http://www.sel.barc.usda.gov/diptera/diptera.htm

• See the information below for additional information on this USDA laboratory.

Fly Head Posture Control: From Behavior to Neurons
http://instruct1.cit.cornell.edu/courses/bionb424/students/acp13/index.html
• This site is the companion for a graduate-level course at Cornell University. It covers the neuroethology of some Dipterans, with specific sections covering behavior, vision, flight, sexual selection, neck kinematics, neuroanatomy, propriosensory input, physiology, phylogenetic relationships, and more.

Fruit Flies of NSW (Tephritidae:Diptera)
http://www.agric.nsw.gov.au/Hort/ascu/fruitfly/fflyinde.htm
• This site is part of the a larger section of infomation (Information on insect and mite pests of agriculture in New South Wales http://www.agric.nsw.gov.au/Hort/ascu/info.htm) and is a good resource for species identification and information.

Glossina morsitans morsitans EST sequencing- The Sanger Institute
http://www.sanger.ac.uk/Projects/G_morsitans/
• Information from the home page states, "the Sanger Institute is a genome research institute primarily funded by the Wellcome Trust".
• As the title of this website implies, it is the sequence data for G. Morsitans and is available for download or access using their online BLAST server. The library consists of approximately 20,000 cDNAs.

Mosquito Genomics Server
http://mosquito.colostate.edu/tikiwiki/tiki-index.php
http://mosquito.colostate.edu/tikiwiki/tiki-page.php?pageName=Mosquito_genomics
• As listed on the home page, "The Mosquito Genomics WWW Server provides the community access to mosquito genomics articles, blogs, databases, discussion forums, file and image galleries, polls, surveys, and wiki. Directory links to other genomics WWW servers and to other WWW servers around the world are provided." It is made available by the College of Agricultural Sciences at Colorado State University.

New Jersey Mosquito Biology and Control
http://www-rci.rutgers.edu/~insects/njmos.htm
• This site is made available by the Entomology Dept. at Rutgers University. Similar to those available through many university and state websites, it provides comprehensive information on mosquitos.

U.S. Geological Survey- West Nile Virus Mosquito Maps and additional information
http://westnilemaps.usgs.gov/usa_mosquito.html
• These maps of mosquitos found to be positive for West Nile Virus may prove useful to some researchers. Additional information is available from the Centers for Disease Control at this site: http://www.cdc.gov/ncidod/dvbid/westnile/mosquitoSpecies.htm

Coleoptera

The Coleopterist
http://www.coleopterist.org.uk/

- This is an online journal for students of the beetle fauna of the British Isles. On this site, you will find a large photo gallery, a county-to-country guide to finding beetles, newsletters, a checklist of recorded species, and additional resources.

Hemiptera

The Bloodsuckers' Rosegarden (Information on Triatomine bugs)
http://www.arose.net/triatoma/index.htm
- This information resource was initially established by this researcher during his PhD work and he has continued to make the information available (and somewhat current). There are images, basic biology information, a bibliography, and additional links.

Hemiptera Site- Systematic Entomology Laboratory
http://www.sel.barc.usda.gov/selhome/hemiptera.html
- See the information below for additional information on this USDA laboratory.

Identification Keys and Checklists for the leafhoppers, planthoppers and their relatives occurring in Australia and New Zealand* (Hemiptera: Auchenorrhyncha)
http://www.agric.nsw.gov.au/Hort/ascu/start.htm
- This site, another section of the NSW Agriculture site, states: "These keys will allow identifications of the Auchenorrhyncha (Hemiptera) known to occur in Australia, New Zealand and neighbouring areas to the taxonomic level of Superfamily, Family, Subfamily or Tribe, depending on the currently accepted classification for each group. A checklist of known species, in their most recently accepted taxonomic combination, is provided for each group for the Australian, Indonesian and New Guinean faunas. Links to checklists and keys to the New Zealand fauna on the New Zealand Arthropod Collection website are provided. Photographic images are provided for many species in each group."
- Here's the Agricultural Scientific Collections Unit's page: http://www.agric.nsw.gov.au/Hort/ascu/index.html

Illustrated Key to the Economically Important Leafhoppers of Australia (Hemiptera: Cicadellidae)
http://www.agric.nsw.gov.au/Hort/ascu/cicadell/ecokey0.htm
- This is part of the NSW Agriculture site and is descibed, "The leafhopper species included in this interactive key (see list) are those of most significance to agricultural activity in Australia. Many other species occur in Australia and, although not directly affecting agriculture itself, may easily be confused with those included here. Care therefore needs to be taken in relying on use of this key for identification of economically important leafhoppers. Confirmation of identifications, requiring dissection of the genitalia of male specimens, needs to be carried out by a specialist cicadellid taxonomist."

Odonata dragonfly biodiversity
http://www.ups.edu/biology/museum/UPSdragonflies.html
- A nice compilation of lists, keys, photos, and additional material from the University of Puget Sound, Museum of Natural History.

Odonata Information Network
http://www.afn.org/~iori/

- From the site, "This Web Page serves as a place to post news stories, information requests, e-mail address directory, events, meetings etc. It also serves as a link to other Odonata related sites." This is another excellent starting point for additional dragonfly and damselfly resources.

Isoptera

Termites- Urban Entomology Program
http://www.utoronto.ca/forest/termite/termite.htm
- Although this program was initially established to foster new and better strategies for control of termites, some excellent research information also resides on this site. Some of the highlights include a phylogenetic tree, beneficial uses, biologic and taxonomic information, distribution data, images, movies, additional links, and a world tour of termites in cyberspace.

Lepidoptera

Butterfly Larvae of Australia
http://www-staff.mcs.uts.edu.au/~don/larvae/butter.html
- See additional information below under **Caterpillars: especially Australian ones**.

The Butterfly Website
http://mgfx.com/butterfly/index.htm
- Billing itself as "the most complete information on butterfly gardening, farming, ecology and education", this site contains articles, photos, conservation alerts, fact sheets, mailing lists, chat rooms, and a very comprehensive list of links to entomology and lepidoptera societies worldwide. The site is geared towards butterfly natural history and hobbyists. It is managed by private individuals with strong interests in butterflies. Contributors include lepidopterists and naturalists.

Caterpillars: especially Australian ones
http://www-staff.mcs.uts.edu.au/~don/larvae/larvae.html
- A nice resource for taxonomy and identification of the unique Lepidopterans of Australia.
- See the **Caterpillars of Australian Moths** and **Butterfly Larvae of Australia,** both listed below, for additional information.

Caterpillars of Australian Moths
http://www-staff.mcs.uts.edu.au/~don/larvae/moths.html
- A nice compilation of moth families. This is from the introduction, " Most of the Caterpillars which we have found are the larvae of moths. Moths far outnumber butterflies both in numbers and species. In Australia, there are over 10,000 named species of moths compared with only about 370 species of butterflies. Added to this, many moths have yet to be collected and named, whereas very few butterfly species remain to be discovered in Australia."
- This website is also made available, in addition to the ones above: **Butterfly Larvae of Australia** http://www-staff.mcs.uts.edu.au/~don/larvae/butter.html

The Dominick Moth Collection
http://zebra.biol.sc.edu/moth.html
- This site is made available by the Univ. of South Carolina. Here is their description, "The Richard B. Dominick Moth and Butterfly Collection consists of 25,215 moths and 1,758

butterflies of which there are 1,167 species; the collection is currently located on the Columbia Campus of the University of South Carolina."

- There is a large list of species collected, references, and an extensive list of links to other Lepidoptera and insect sites.

Lepidoptera and some other life forms
http://www.funet.fi/pub/sci/bio/life/intro.html

- This site was prepared by a private citizen (who may be affiliated with the Finnish IT center for Science). It has some good background and taxonomic information; including, an extensive image database. Additional resources and links are also listed.

Lepidoptera Site- Systematic Entomology Laboratory
http://www.sel.barc.usda.gov/lep/lep.html

- See the information below for additional information on this USDA laboratory.

Nomina Insecta Nearctica
http://www.nearctica.com/nomina/main.htm

- This is from their home page, "Nomina Insecta Nearctica is a complete synonymical checklist of the approximately 90,000 species of insects of North America north of Mexico published by Entomological Information Services in 1996 and 1997 in four volumes and a CD-ROM. An abbreviated version of this checklist is now available on Nearctica. The list contains all of the species of insects of North America with the synonyms removed." The special section for Butterflies and Skippers has excellent background information and images.

PheroNet
http://phero.net/index.html

- The highlight of this site is the 'pherolist' (http://www-pherolist.slu.se/cgi-bin-pherolist/pherolist.cgi) which is, "a database of chemicals identified from sex pheromone glands of female Lepidopteran insects and other chemicals attractive to male moths." Additional product information relevant to capture/ husbandry of Lepidopterans and other insects is also provided.

Sericulum
http://www.sericulum.com/index.html

- This commercial site, like many others of its kind, offers technical information and references to current and potential customers in support of its products. Some details included are: information on rearing, life cycles, artificial diets, and some additional on-line resources.

Siphonaptera

Fleas (Siphonaptera)
http://www.zin.ru/Animalia/Siphonaptera/index.htm

- This site is made available by the Laboratory of Parasitology, Zoological Institute, Russian Academy of Sciences. You can explore flea ecology, physiology, and morphology. Also included are a database, taxonomic classifications, images, host data, and additional background information.

Miscellaneous

The Agricultural Scientific Collections Unit
http://www.agric.nsw.gov.au/Hort/ascu/info.htm
- "Information on insect and mite pests of agriculture in New South Wales."

Animal Diversity Web
http://animaldiversity.ummz.umich.edu/site/accounts/information/Insecta.html
- Here is the desciption from the site, "Animal Diversity Web (ADW) is an online database of animal natural history, distribution, classification, and conservation biology at the University of Michigan. Animal Diversity Web has thousands of species accounts about individual animal species. These may include text, pictures of living animals, photographs and movies of specimens, and/or recordings of sounds. Students write the text of these accounts and we cannot guarantee their accuracy. Descriptions of levels of organization above the species level, especially phyla, classes, and in some cases, orders and families. Hundreds of hyperlinked pages and images illustrate the traits and general biology of these groups. Professional biologists prepare this part."

Australian Insect Common Names
http://www.ento.csiro.au/aicn/index_no.htm
- As listed on the site, " This website is based on the CSIRO Handbook of Australian Insect Names - 6th edition, 1993. The database of names behind that Handbook has been updated and augmented to reflect taxonomic changes, new names and newly recorded species. Inevitably, we will have overlooked some changes in nomenclature or potential additions."

BioImages
http://www.bioimages.org.uk/index.htm
- The home page describes this collection as follows, "The Virtual Field-Guide for UK Bio-diversity. Content: This site offers a large selection of pictures of Natural History objects, mostly British in origin. Purpose: The images are presented to illustrate biodiversity and as an aid to identification. While pictures alone are generally NOT sufficient for identification, by showing different stages, states and views of the organisms more information can be offered than is available in field-guides."
- This section is a comprehensive linked index.
  http://www.bioimages.org.uk/HTML/SHORTCUT.HTM

BioOne
http://www.bioone.org/bioone/?request=index-html
- This commercial publisher site contains some excellent background information with regard to species identification and current research. Many articles and additional resources are open to the public; although, sections of this site are only available with subscription. Nevertheless, one aim of this site is to provide expanded access to research results.

The Bugwood Network
http://www.bugwood.org/
- Here's their mission statement: "The Mission of The Bugwood Work Group is to gather, create, maintain, promote the use of, and economically distribute digital information both as resources and as tools to enhance and complement information exchange and educational activities primarily in the fields of entomology, forestry, forest health and natural resources." Links to

other collaborate insect resources (i.e., Invasive and Exotic Species of North America http://www.invasive.org/) are provided as well as extensive taxonomic information.

Clemson Entomology
http://entweb.clemson.edu/insectinfo/index.htm

- Some of the more interesting features of this site, hosted by the College of Agriculture, Forestry and Life Sciences include: insect pictures, a virtual museum (where you can perform a very cool, self guided journey), and an insect information series (a very comprehensive collection of fact sheet-style publications.

Cooperative Extension Catalog of Publications– Insects & Pests
http://ianrpubs.unl.edu/insects/

- Similar to many other excellent cooperative extension resources available, this site hosts an extensive list of insects and pests publications made available by the University of NE at Lincoln.

CRC Press
http://www.crcpress.com/shopping_cart/categories/categories_products.asp?parent_id=446&so=1

- Book descriptions, with regard to Entomology, categorized and made available by CRC Press. Also listed are descriptions and related titles.

Crop Knowledge Master
http://www.extento.hawaii.edu/kbase/Crop/crop.htm

- This site, "was prepared by an inter-disciplinary team of entomologists and plant pathologists from the University of Hawaii, College of Tropical Agriculture and Human Resources, and Hawaii Department of Agriculture." The site also states, "Everything you wanted to know about agricultural pests."

Defra- Pest and Diseases
http://www.defra.gov.uk/planth/pests.htm#issues

- Here is the current law in the U.K. as stated on this official government site, "Under plant health legislation, a number of plant pests and diseases are classified as quarantine organisms and are therefore subject to statutory control. Anyone finding or suspecting the presence of a quarantine organism must contact their local Plant Health and Seeds Inspector (PHSI) immediately.
- Identification posters, Information sheets, Information Booklets and Quarantine Information Cards are available on a number of these pests and diseases." This site is yet another example of information available on a related topic that also serves as a valuable alternative resource.

Ecowatch
http://www.ento.csiro.au/Ecowatch/about.html

- From the site, " This site provides information on a wide range of invertebrate groups. It includes an overview of the biology, ecology and life cycle of invertebrates likely to be encountered and all insect orders found in Australia. The ECOWATCH site focuses on the Ecowatch survey area of the Murray Riverland and many of the images and specific information relate to individuals found in the local area. Follow the links below to learn more about insects and their allies in Australia." This site is further divided by species at the insects home page, with excellent graphics and background information. Make sure to see this page:

http://www.ento.csiro.au/Ecowatch/Insects.htm

Entomology at Colorado State University
http://www.colostate.edu/Depts/Entomology/

- Some excellent resources available via this site include: insect images, movies, books, selected publications/ databases, meetings, and links to additional entomology departments around the world.

Entomological Society of America
http://www.entsoc.org/index.html

- This is listed on the site, "The Entomological Society of America (ESA) is the largest organization in the world serving the professional and scientific needs of entomologists and people in related disciplines. Founded in 1889, ESA today has more than 6,000 members. This number includes educators, extension personnel, consultants, students, researchers, and scientists from agricultural departments, health agencies, private industries, colleges and universities, and state and federal governments."
- Additional resources include information from their annual meetings. Here are two previous events:
  http://esa.confex.com/esa/2003/
  http://esa.confex.com/esa/2001/techprogram/meeting_2001.htm

Entomology Index of Internet Resources
http://www.ent.iastate.edu/List/

- This very comprehensive site is maintained at Iowa State University and is compiled by J.K. VanDyk and L.B. Bjostad. Categories include checklists, companies, bibliographies, databases, images, insect collections, pest management, listserves, online courses, regulations, professional societies, and software. The 'organisms and species' section contains descriptions and links to tens of other sites ranging from *Drosophila* to arachnids. Of particular interest is the medical entomology category which contains links to veterinary parisitology to vector biology to forensic entomology.

Entomology Texas A&M University
http://insects.tamu.edu/

- This site is another classic example of the vast resources both at the departmental and cooperative extension at this university and many others throughout America. Some of the more interesting topics included on this site are: insect images and sounds, animations, movies, and an extensive collection of insect links.

Environmental Protection Agency- Benthic Macroinvertebrates in Our Waters
http://www.epa.gov/bioindicators/html/benthosclean.html

- This page features benthic insects found in clean, moderately polluted, and severely polluted streams. Life cycles are included as well as physiology, images, background, and additional web links.

Featured Creatures
http://creatures.ifas.ufl.edu/index.htm

- The site states, "The site is a cooperative venture of the University of Florida's Department of Entomology and Nematology and the Florida Department of Agriculture and Consumer Services' Division of Plant Industry." It has a well organized and searchable index. Provided

are profiles of insects, mites, nematodes, and other organisms. Information is geared for both professionals and the public.

Florida Entomologist
http://www.fcla.edu/FlaEnt/

- This site contains free access to journal articles from *Florida Entomologist* since 1917 and is sponsored by the Florida Entomological Society and Florida Center for Library Automation. The articles contained focus on insect issues in the Americas and include natural history, genetics, conservation, physiology, anatomy, pest control, and laboratory rearing. The database is easily searched.

Forestry Images
http://www.forestryimages.org/

- This site is a companion to Insect Images (listed below). It is an excellent source for forest health, natural resources, and silviculture images. There is an emphasis on educational applications. Make sure also to see more at the Bugwood Network (listed above).

HYPPZ
http://www.inra.fr/Internet/Produits/HYPPZ/pa.htm

- The home page of this site is in French, which roughly translates into, "Database, encyclopedic HYPPZ gathers 297 'cards' describing pests (insects, acarina, rodents, nematodes, gastropods and small vertebrate) important in Western Europe, a glossary of the terms of Zoology (280 words and concepts) and a table of the cultures and fruit trees concerned (more than 80 species). The unit is illustrated with color photographs (approximately 200) and some 150 original drawings."
- The sections below, available in English, provide information on taxonomy, biology, life cycle, and more. There is also a large number of images.
  Glossary http://www.inra.fr/Internet/Produits/HYPPZ/glossary.htm
  Species http://www.inra.fr/Internet/Produits/HYPPZ/species.htm

Insect Bibliography Server
http://entobib.unl.edu/

- This site includes bibliographies on Chironomidae (midges), FORMIS 95 (ants), Face Fly, Fire Ant, Horn Fly, Screw worm, and Stable Fly. Bibliographies under development include ITS (Intergenic Transcribed Spacer region, genetics), Insect Genetics, Insect Nematodes (entomopathogenic nematodes), and Parasitoids (filth fly parsitoids). The status of the individual bibliographies varies. Links to other insect sites are also included.

The Insects Home Page
http://www.earthlife.net/insects/six01.html

- Although, this site appears to be geared towards children, there is some good taxonomic information, a key to various insect orders, rearing information, and additional listings of suppliers.

Insect Images
http://www.insectimages.org/

- From the about page, "InsectImages.org has been under development for a number of years, and is the result of the efforts of a large number of people. In the mid-1990's we recognized a

need for quality photographs of forest insects and disease organisms to use in information technology applications." Special thanks to InsectImages and Chuck Bargeron for his help and permission to use images from their collection on the cover page of this publication.

The Insects of Cedar Creek
http://cedarcreek.umn.edu/insects/
- This site is made available by the Univ. of Minnesota. It consists of a large online image collection and excellent associated taxonomic information. There are also alphabetical listings and a checklist of Minnesota insects.

Insect Orders and Common Families
http://eny3005.ifas.ufl.edu/lab1/index.htm
- This site contains links for information on the various orders of insects. It connects to various web pages of many of the sites described in this document.

Insects on the Web- Iowa State University Entomology
http://www.ent.iastate.edu/
- The site has the following description, "Entomologists at Iowa State university have engaged in teaching, research, and extension for more than a century. Professor Herbert Osborn taught the nation's first entomology course in 1880, beginning a tradition of excellence in basic and applied entomology. The Department of Entomology faculty work to provide an excellent education, develop innovative research programs and supply a creative, highly visible problem-solving extension program. The department is part of the College of Agriculture at Iowa State, which is Iowa's land-grant university." Also included are an image gallery, integrated pest management information, insect zoo complete with webcam, two insect-related listservs with archives, and additional extension information.

Insect Photos Identification- (A Strange Site)
http://strano16.interfree.it/home.htm
- As stated on this site, "An easy guide on identification of insect order. More than 200 insect photos." Some high quality images are available on this easy to search database.

Integrated Crop Management- Insects and Mites
http://www.ipm.iastate.edu/ipm/icm/indices/insectsandmites.html
- This site contains an excellent compilation of, "Detailed, research-based articles for better management decisions produced weekly from spring to fall." This section on insects and mites, published by the Entomology Department at Iowa State University, is only one part of the full selection at:
  http://www.ipm.iastate.edu/ipm/icm/default.html

International Centre of Insect Physiology and Ecology
http://www.icipe.org/cgi-bin/WebObjects/ICIPE.woa
- Here is a description from the site, "The International Centre of Insect Physiology and Ecology (ICIPE) is a unique inter-governmental research organisation which specialises in research and development into arthropod-based issues which impact on the economics and welfare of tropical developing countries. Based in Nairobi, Kenya, the Centre was founded in 1970 by a Kenyan scientist, Professor Thomas R. Odhiambo."

Introduction to the Uniramia
http://www.ucmp.berkeley.edu/arthropoda/uniramia/uniramia.html

- This site is made available by the University of California Museum of Paleontology. It's mission is, "to investigate and promote the understanding of the history of life and the diversity of the Earth's biota through research and education." They describe Uniramia as, "the largest major group of arthropods that includes insects, millipedes, centipedes, and their relatives." Included are specific sections on: the fossil record, life history and ecology, systematics, and morphology.

Memorias do Instituto Oswaldo Cruz On-line
http://memorias.ioc.fiocruz.br/main.html

- This traditional biomedical journal features many of the citations referenced in the bibliographic sections of this publication. I have listed it merely as an excellent resource for those interested in obtaining full-text articles.

Neuroptera
http://www.cals.ncsu.edu/course/ent425/compendium/neurop~1.html

- This site is part of a larger compendium at: http://www.cals.ncsu.edu/course/ent425/compendium/index.html
- The information is made available by the Entomology Dept. at NC State University. There is a wealth of information, such as life history and ecology, classifications, images, and additional background and links. It was designed to instruct graduate-level students as part of a class. There are many sites similar to this available through many college and university sites.

PAN Pesticides Database
http://www.pesticideinfo.org/List_EcoChemSpecies.jsp?Taxa_Group='Insects'

- As listed on this site, "The Aquatic Ecotoxicity section includes 223,853 aquatic toxicity results from U.S. EPA's AQUIRE database. These data can be searched by species, Chemical or Effect."
- Even though this database is geared toward the toxicologist, there is some excellent taxonomic information.
- The is the insects section of many others listed at this section of the site: http://www.pesticideinfo.org/Search_Ecotoxicity.jsp#Species

Parasites and Parasitological Resources
http://www.biosci.ohio-state.edu/~parasite/home.html

- Included in this site, made available by the College of Biological Sciences at The Ohio State University, are: an extensive image database, taxonomical listings, life cycles information, and labeled images/ drawings.

The Pherobase
http://www.pherobase.com./

- This site consists of a database of insect pheromones and semiochemicals. Although it is a private site, there is an extensive listing of insects and associated semiochemical compounds. Also included are: taxonomic information, chemical structures, and extensive references.

Resistant Pest Management: Arthropod Database
http://www.pesticideresistance.org/DB/

- This database states, "The MSU Resistant Pest Database includes mites, spiders and insects that have had one or more documented cases of resistance." Currently, there are 543 cases. Listed individually and also searchable are: list of resistance cases by country, citations, and pesticides.

Rutgers Entomology
http://www-rci.rutgers.edu/~insects/
- This university website, like many others of its kind, offer an incredible amount of information including a worldwide directory of entomology departments, museum information, course/ seminar listings, links to numerous cooperative extension resources, and more.

Systematic Entomology Laboratory- USDA
http://www.sel.barc.usda.gov/selhome/selhome.htm
- This USDA laboratory's mission is to:
  - Develop comprehensive classification systems for insects and mites on a world basis.
  - Furnish taxonomic services to Federal, state, and private organizations involved in research and action programs in agricultural, biological, and health sciences.
  - Cooperate with the Smithsonian Institution on a working basis in the continuing development and maintenance of a large portion of the U.S. National Collection of Insects as a working tool to support systematic studies and identification needs of Federal, state, and private user organizations.
  - Develop information, storage, and retrieval systems for systematic and biological information.
- There are separate sections for various different orders; also an insect and mite database is available. Additionally, there is access to the national collections of insects and mites. See the insects and mites section at: http://www.sel.barc.usda.gov/selhome/insect_mite.html

Tree of Life
http://tolweb.org/tree/phylogeny.html
- As stated on the site, "We envisage the Tree of Life being used by those interested in locating information about a particular group of organisms, by biologists seeking identification keys, figures, phylogenetic trees, and other systematic information for a group of organisms, and by educators teaching about organismal diversity."
- This site is broken down into further sections, such as these:
  Insecta http://tolweb.org/tree?group=Insecta&contgroup=Hexapoda
  Hemiptera http://tolweb.org/tree?group=Hemiptera&contgroup=Hemipteroid_Assemblage
  Heteroptera http://tolweb.org/tree?group=Heteroptera&contgroup=Hemiptera
- It should be noted that there is a huge amount of information on this site with exceptional taxonomic descriptions including excellent background data and references.

The University of Florida Book of Insect Records 2003
http://ufbir.ifas.ufl.edu/
- Since 1994, graduate students in the Insect Ecology course at the University of Florida have contributed chapters to the University of Florida Book of Insect Records that name insect champions and documents their achievements. Each chapter deals with a different category of record. The records range from fastest flier to most tolerant, cold or largest blood meal, and greatest bioluminenence. All records include a research paper and references.

The University of Queensland Insect Collection

http://www.uq.edu.au/entomology/uqic.html

- This collection contains ~700,000 insects and related arthropods from Australia and elsewhere. You can browse their collection on-line, listed by order. Like many other entomology university and museum sites, the internet provides the convenience of browsing and researching a collection remotely.

U.S. Geological Survey- Stoneflies of the United States

http://www.npwrc.usgs.gov/resource/distr/insects/sfly/sflyusa.htm

- This official U.S. Dept. of Interior website states, "This Web site is a "work in progress," consisting of information on the known distribution of stoneflies (Plecoptera) in the United States. Distribution maps and county checklists were created by extracting information on stonefly distribution from publications listed in References." Additional information includes taxonomic data (incorporated into the distribution maps), bibliographic references, and links to additional web resources.

Biocontrol Related

Agrobiologicals

http://www.agrobiologicals.com/index.html

- As stated in their scope statement, "Biopesticides, integrated pest management (IPM), organic farming and alternative inputs to agriculture and related production systems have been major areas of involvement by members of the CPL Scientific Group of companies for more than a decade. During this time, CPL has developed a range of products and services including publications and reports (CPL Press)." There is a wealth of background information on hosts, problem pests, and biocontrol insects.

Biobest n.v.

http://207.5.71.37/biobest/en/producten/nuttig/default.htm#

- This site contains information on a selection of beneficial insects and mites used for biological control. Although the contents is for arthropods this company sells, excellent background and technical data is available.

Biological Control: A Guide to Natural Enemies in North America

http://www.nysaes.cornell.edu/ent/biocontrol/

- From the introduction on the home page, "This guide provides photographs and descriptions of biological control (or biocontrol) agents of insect, disease and weed pests in North America. It is also a tutorial on the concept and practice of biological control and integrated pest management (IPM)." Information is contained for a wide audience and includes approximately 100 species of pests. Descriptions of life cycles and habitats is also included.

Compendium on Post-harvest Operations

http://www.fao.org/inpho/compend/toc_main.htm

- This site is produced by the Information Network on Post-harvest Operations and led by the Food and Agriculture Organization of the United Nations in partnership with GTZ and CIRAD. There is some excellent background information on Coleopteran and Lepidopteran species, including control methods and references.

The Corn Rootworm Home Page

http://www.ent.iastate.edu/pest/rootworm/

- Here is the on-line description, "This site is intended to serve as a central reference point for information about the Corn Rootworm Beetle in the midwestern United States."
  It was created by the Entomology Dept. at Iowa State University. There is an interactive node-injury scale available and state listings of corn rootworm web resources.

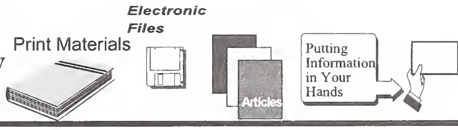
International Society for Pest Information
http://www.pestinfo.org/default.htm
- From the site, "ISPI is a non-profit organization, registered in Darmstadt, Germany, with the aim to promote information exchange on: animal pests, diseases and weeds in agriculture, forestry and stores arthropods (e.g. insects) which are harmful to livestock or effect humans directly. We collaborate mainly with scientists and research institutes. Among others, we assemble addresses, lists of pests, and scientific literature."
- There are locust and grasshopper pests and thrips pests databases, as well as listings of related journals and other web resources.

Knowledge Master
http://www.extento.hawaii.edu/kbase/default.htm
- The authors' description is, "Knowledge Master contains general information on pest hosts, distribution, damage, biology, and management in the form of pest summaries, reports and recommendations, and resource information. Knowledge Master was prepared by an inter-disciplinary team of entomologists and plant pathologists from the University of Hawaii, College of Tropical Agriculture and Human Resources, and Hawaii Department of Agriculture."
- Additional information includes a resource Toolbox with identification keys, slide mounting procedures, and quarantine regulations. Also provided is some excellent background on managing several species of fruit flies.

PEST CABWeb
http://pest.cabweb.org/index.htm
- This site is made available by CABI publishing and includes this description, "Covering entomology, nematology, weed science, biological control, plant pathology and many other aspects of pest management: PEST CABWeb® demonstrates a unique combination of scientific expertise and authoritative information resources." Also included are taxonomically- annotated maps and several relevant journals with links to full-text articles.

Plant Quarantine
http://www.eppo.org/QUARANTINE/quarantine.html
- Although this site is geared toward pest control, there exists some excellent background information on many different insects, including geographical information and factsheets. See their listing of quarantine species at:
  http://www.eppo.org/QUARANTINE/Data_sheets/datasheets.html

Suppliers of beneficial organisms in North America
http://www.cdpr.ca.gov/docs/ipminov/ben_supp/contents.htm#top
- This site is made available by the California Environmental Protection Agency and is a list of commercial suppliers of biocontrol organisms. Also included are a taxonomic index and selected references and web sites for biocontrol and integrated pest management.



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